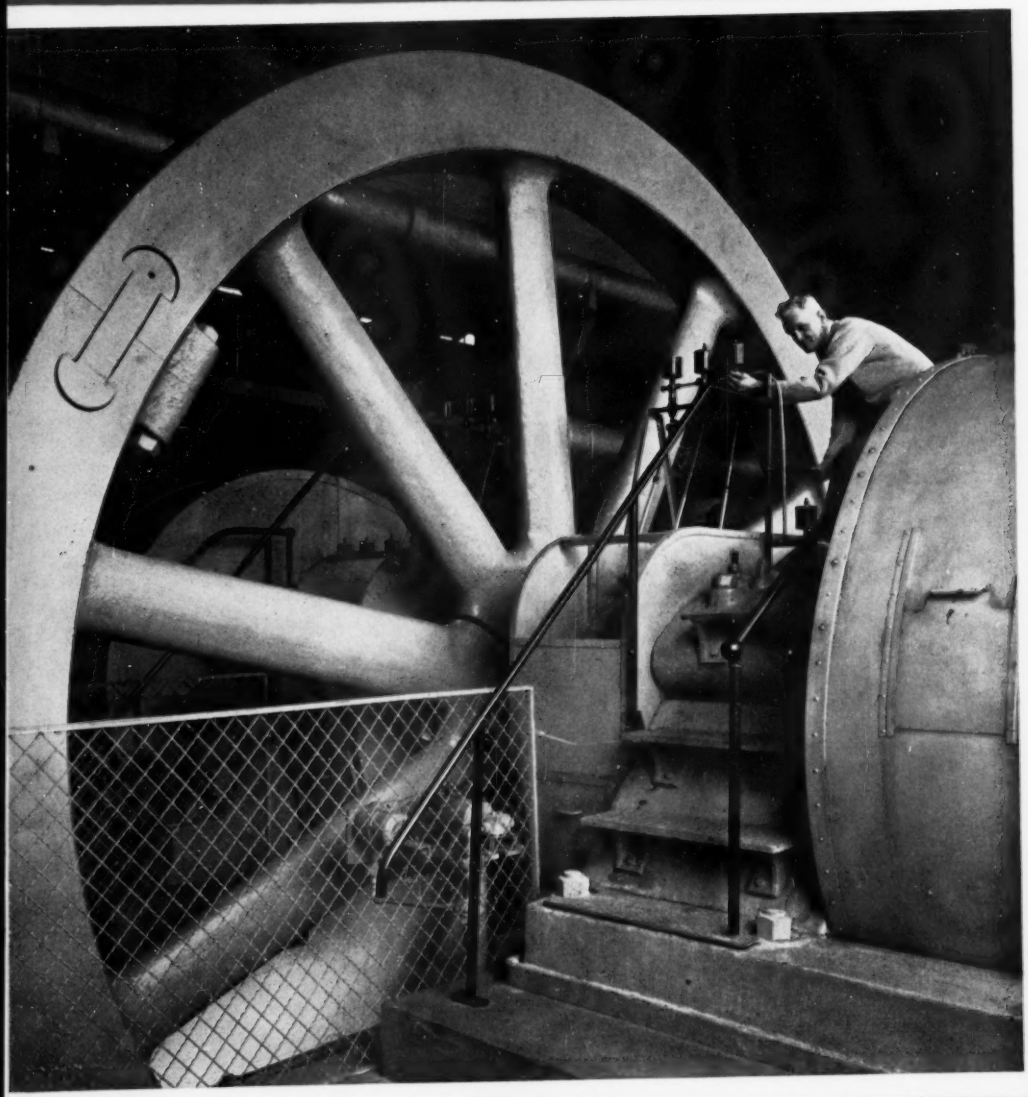
Compressed Air Magazine

JANUARY 1958



HUGE COMPRESSOR OF THE TWENTIES

2780-hp engine-compressor weighed 343 tons, had 20-foot flywheel

(SEE INDEX PAGE AND PAGE 12)

VOLUME 63 • NUMBER 1

NEW YORK • LONDON

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

BLUE RIBBON BLOWERS

THE BLOWERS THAT PUT MORE MINUTES IN EVERY MAN-HOUR

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 201 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have.)

Circle 1A on reply card

The secret of cruising in orbit
Was told to his canine by Corbett:
"When you're smacked in the face, by stardust in space
Let a Staynew Filter absorb it."

Sputnik, Muttnik, or Whatnik *we've* always known that Dollinger Filters are simply "Out of this World." That's what we've been trying to tell you these past months! But I suppose you've become immune to such claims and just haven't bothered to investigate.

Possibly there is a moral here (If you like morals):

Perhaps your biggest competitor did investigate, and right now a Dollinger Staynew Filter may be helping him make his product better than ever.

Seriously, shouldn't you investigate the design advantages of Dollinger Filters? It will cost you nothing and you may save yourself many headaches.

STAYNEW MODEL CPHS PIPE LINE FILTER

has the exclusive "double action principle." Air is first deflected to outer walls of Filters and forced downward at high speed. Water, oil, and heavier particles of rust, etc. are thus deposited in base. Mechanically cleaned air then rises to pass through filtering medium which removes lighter airborne particles. This "double action" design eliminates need for frequent cleaning.

Inexpensive, simple to install, Dollinger Pipe Line Filters pay for themselves in reduced maintenance alone. Why not talk over your filtration problems with a Dollinger engineer . . . or write for Bulletin 200 which gives engineering data on pipe line filters.
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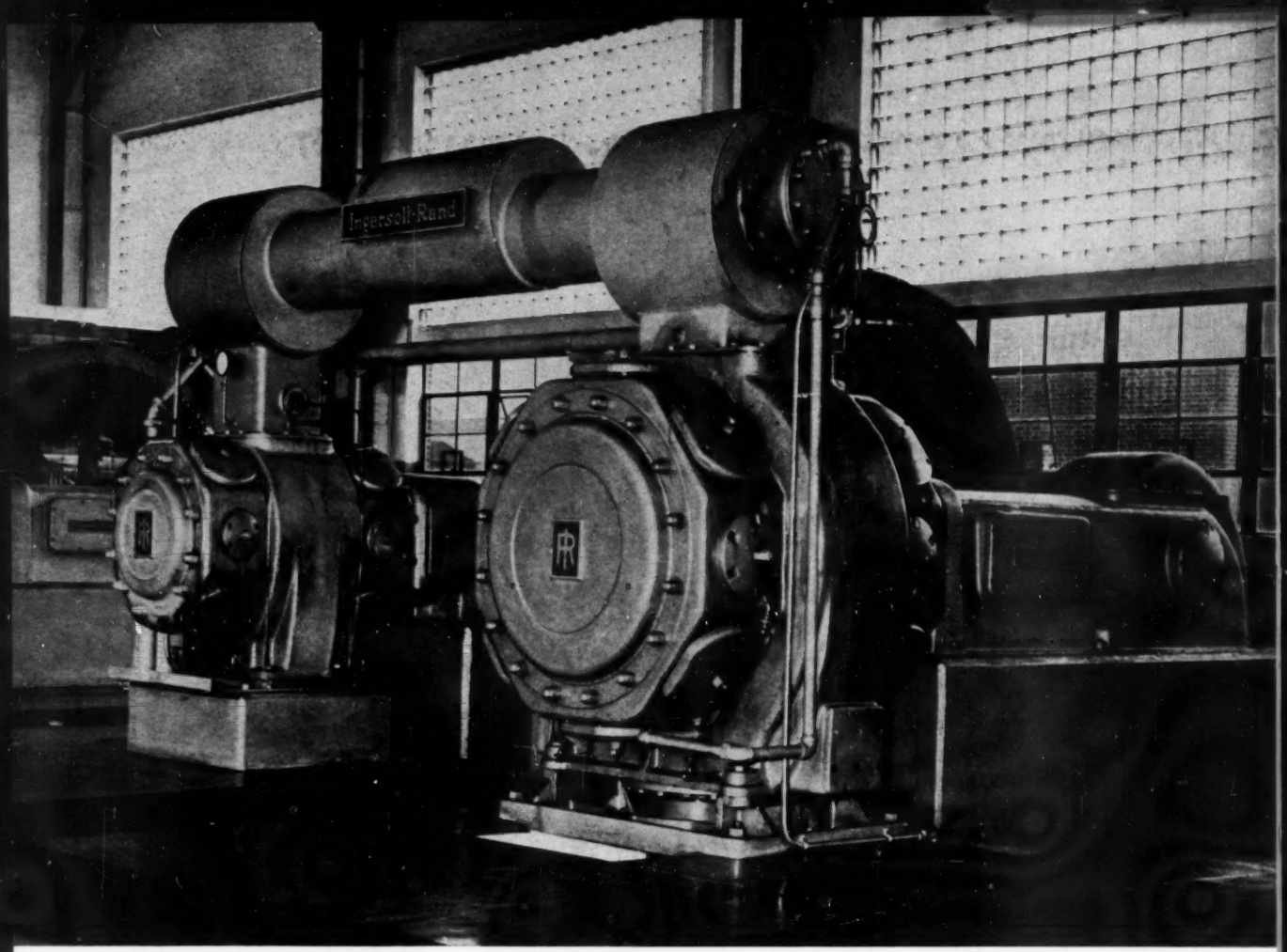

How to stop rust and harmful deposits in air compressors

. . . USE TEXACO REGAL OIL R & O

A sure way to prevent rust and harmful deposits in compressor systems is to lubricate and protect them with Texaco Regal Oil R & O. It is both rust and oxidation inhibited, protects cylinders, valves, etc. against the formation of rust and gum . . . helps keep compressor operation clean and efficient, whatever the working conditions.

There is a complete line of Texaco Regal Oils R & O. A Texaco representative will recommend the right one for your type, size and make compressor and operating condition. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write: The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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Compressed Air Magazine

Founded 1896

VOLUME 63 NUMBER 1 **January 1958**

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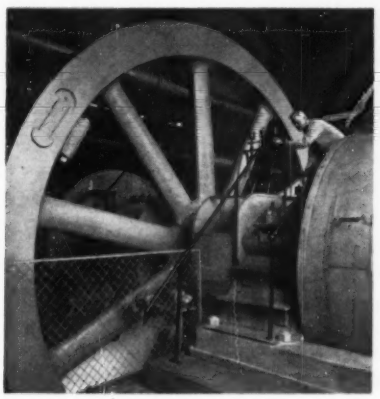

ON THE COVER

OUR cover picture this month indicates the size of a gas compressor installed in the 1920s in Southern California Gas Company's Ducommun station. The flywheel was 20 feet in diameter, 16 inches across the face and weighed 75,000 pounds. As told in the lead article, this old machine and eight similar units were replaced by eight modern gas-engine-driven units. Even though the new machines occupy considerably less space and require fewer operating personnel, they have greater capacity than the 2780-hp steam giants.

FEATURE ARTICLES

Page 12 **Saving By Modernizing**—*C. H. Vivian*
The installation of modern gas-engine-driven compressors at a Southern California Gas Company station has resulted in great economies. The machines replaced some giant compressors of the Twenties, being installed in considerably less space and requiring fewer men in operating crews.

19 **Hydro Works On The Kurobe**—*D. C. Garfield*
The Japanese have traditionally relied on hydroelectric power in their fuel-poor nation, although some thermal stations have been built since the war. A current water-power project is detailed.

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Air power comes to the fore in helping maintain bearings on roller freight cars.

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Alcoa tests aluminum impellers in a high-speed whirl-pit. Air turbines are used to develop the velocities required.

24 **To Build A Better Mower**
Lawn Boy power mowers are built with the aid of pneumatic torque-control Impactools.

26 **Milk Displacement**—*Robert James*
Oil-free air moves milk in dairies.

28 **Chattanooga's Cable Choo Choo**—*Paul C. Ziemke*
The "World's Steepest and Safest" incline railway is described and some of the engineering aspects discussed.

30 **"Daylight Through The Mountain"**—*S. M. Parkhill*
The Engineering Institute of Canada recently issued a volume about Walter and Francis Shanly. One of their greatest projects was tunneling through the Hoosac Mountains.

36 **Subaqueous Maintenance At Disneyland**
A good deal of engineering know-how keeps the playground going.

36 **Salvage of 300-Year-Old Man-of-War**
Swedish engineers are refloating an ancient warship.

37 **Community National Bank Gets A Lift**
A teller's cage rises from the sidewalk to serve drive-in customers.

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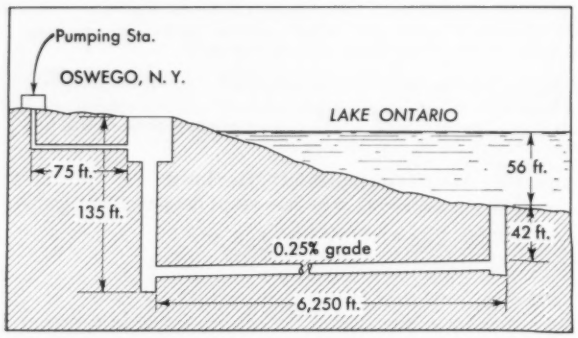
It's not just a bit of metal you're buying... it's FEET OF HOLE!

Three Ingersoll-Rand JR-38B Jackdrills with 1⅜" Carset Jackbits, drilling through hard sandstone in the 8' diameter Oswego Water Tunnel. Thirty holes were drilled for each round, and two rounds were drilled, blasted and mucked per shift.

CARSET JACKBITS average 500 FEET

in Hard Sandstone on the OSWEGO TUNNEL JOB



Simplified schematic diagram of the Oswego Water Tunnel project. Drilling started with the 135 ft. access shaft and water riser. The upper 33½ ft. is square, the remainder being circular, 12 ft. in diameter. The 6,250 ft. tunnel, 8 ft. in diameter, was driven on a 0.25% up grade, to a point more than a mile out under the lake, ending 42 ft. below the lake bottom under a 56 ft. depth of water. A riser was driven upwards to within a few feet of the lake bed and the rock plug blasted free after which a strainer and inlet structure were set in place over the riser, a sump below tunnel line catching the muck. A 75 ft. tunnel 30'-0" below ground level carries water from the riser to the pumping station. Roof bolts were set in the main tunnel as a safety measure.

EXTENDING more than a mile out under the waters of Lake Ontario, the Oswego Water Tunnel brings an abundance of offshore fresh water to the city of Oswego, N. Y.

Driven by Herbert F. Darling, General Contractor, Williamsville, N. Y., this 6,250 ft. long tunnel, 8 ft. diameter, was drilled with Ingersoll-Rand JR-38B Jackdrills and 1⅝" Carset Jackbits. By sharpening the bits with machine precision on an I-R Jackbit Grinder and maintaining correct cutting angles bit footages were boosted from 300 to 500 feet. Rock was hard gray sandstone.

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OF COMPRESSED AIR

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MICRO-CLARITY AT MINIMUM COST

They look like twins... but one is synchronous

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New from Louis Allis — *the most compact and efficient synchronous induction motor on the market* . . . the revolutionary "Syncro-Spede." It's the *only* synchronous motor built in standard NEMA frames for comparable ratings in any enclosure.

The space-saving "Syncro-Spede" has no external excitation, wound rotating fields, collector rings or brushes—offers simplified control and low-cost operation. And it's virtually maintenance-free.

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"Syncro-Spede" is the low-cost answer to such demanding synchronous applications as *precise adjustable-frequency multi-motor systems* . . . high-frequency generator drives and constant-speed conveyor drives . . . precision timing and metering devices . . . recording instrument drives . . . any system requiring constant speeds from no-load to full-load.

"Syncro-Spede" sizes range up to 100 hp. For information and expert application engineering assistance, contact your nearby Louis Allis District Office or write directly to The Louis Allis Company, 437 East Stewart Street, Milwaukee 1, Wisconsin.

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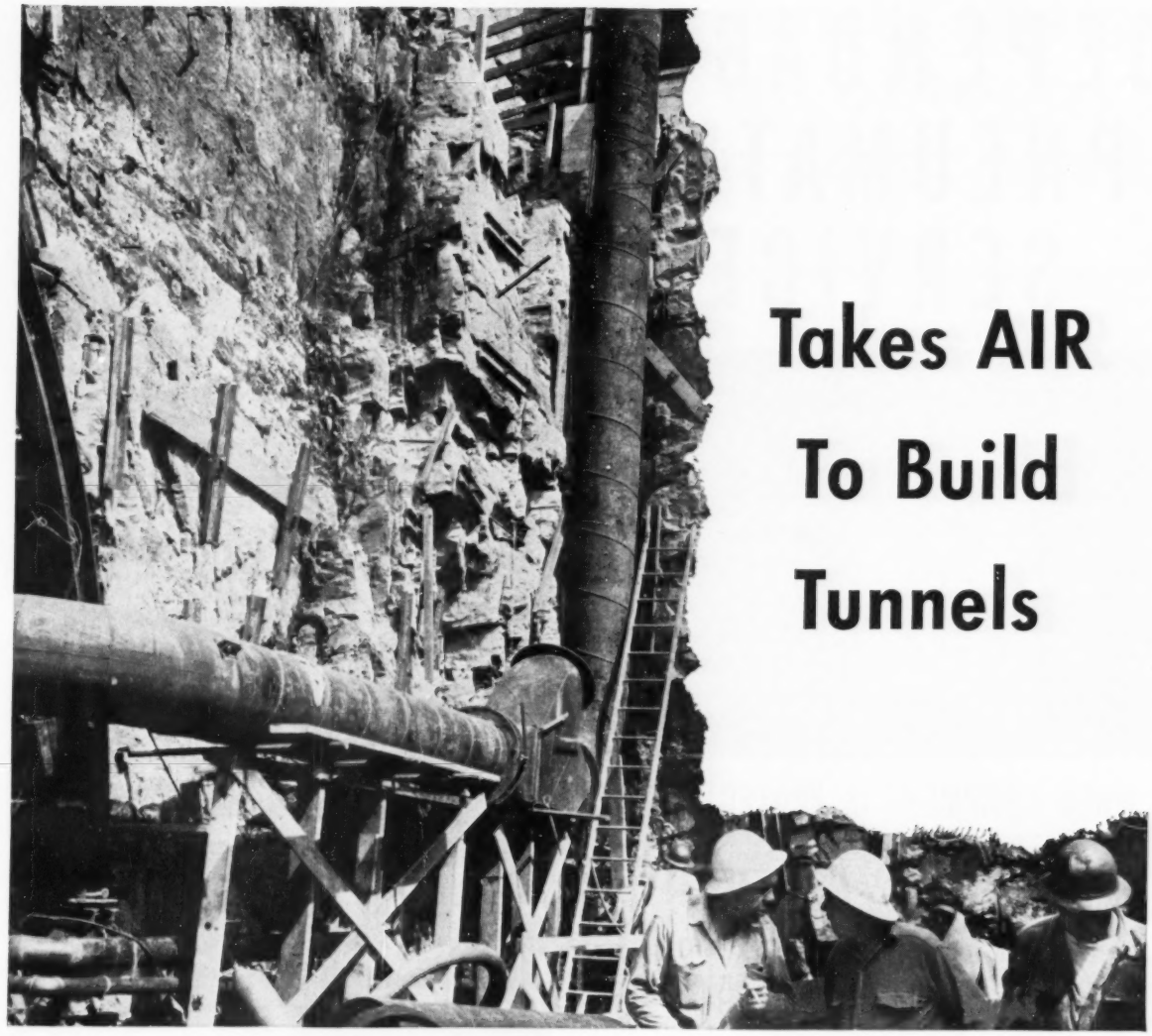

Takes AIR To Build Tunnels

When air is a construction ingredient, it pays to carry it through lines of dependable NAYLOR spiralweld pipe. It's the one lightweight pipe built to give you heavy-wall performance. It's extra strong and safe—easier to handle and faster to install, especially with the one-piece NAYLOR Wedgelock coupling. It's a wise choice for ventilating lines or pressure lines for pneumatic equipment.

Write for Bulletin 507 which tells the complete story.

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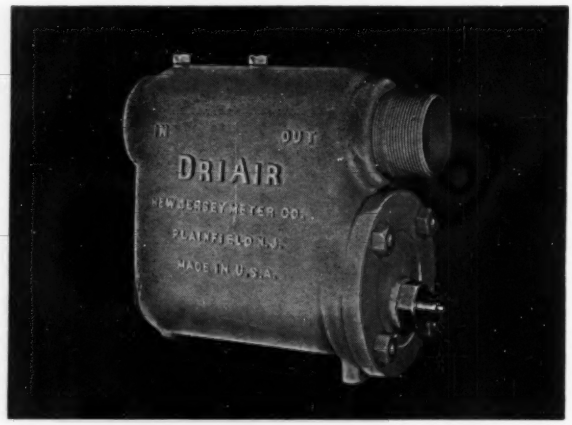
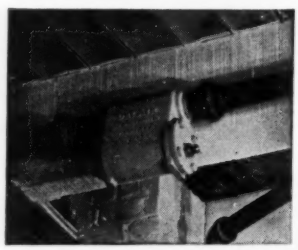


WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper — resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

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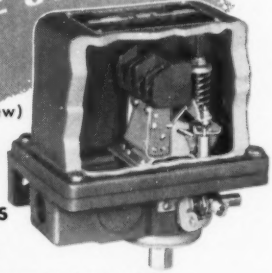

(cutaway view)

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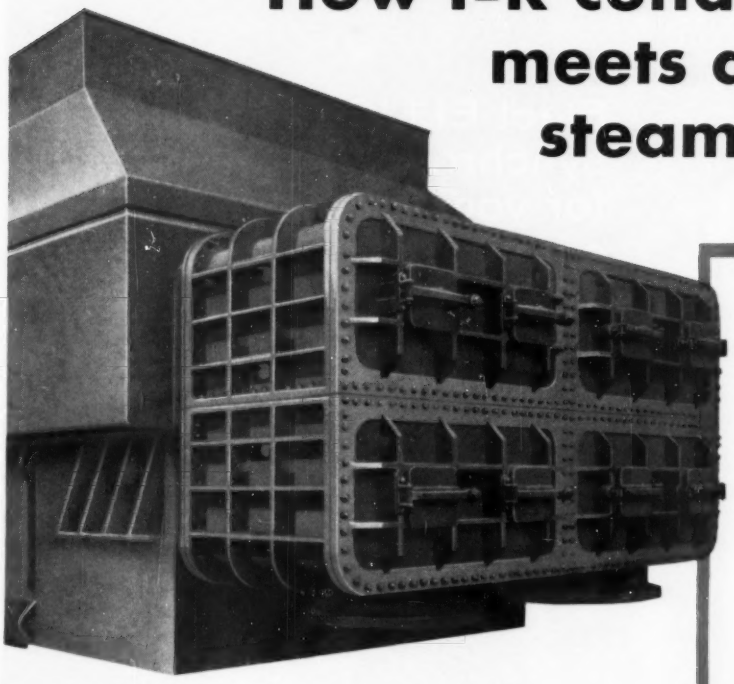
How I-R condenser design meets all of today's steam plant needs

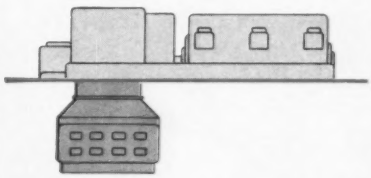


...Sets the pace in turbine-condenser adaptability

Permitting variations in condenser length, width and height without sacrificing performance, the Ingersoll-Rand rectangular design proves readily adaptable to all steam plant needs. Dimensional proportions can be changed over wide limits without departing from the basic standard arrangement of internal elements. This means maximum utilization of the condenser space available.

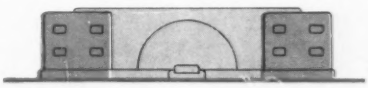
Continued refinements in I-R design are contributing to ever smaller space requirements for a given condensing capacity. These developments conform with the modern trend to higher turbine efficiencies and more compact turbine designs in reduced foundation areas for a specified kw rating.

Your I-R engineer will be glad to give you further information and submit recommendations to meet your particular requirements.



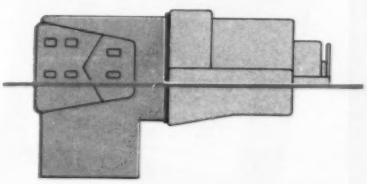
BOTTOM-EXHAUST TURBINE

Serving a 135,000-kw turbine, this condenser having 65,000 sq. ft. surface requires a headroom of only 14 feet 8 inches. It assures maximum economy of installation, operation and maintenance.



SIDE-EXHAUST TURBINE

Mounted on the turbine floor, the twin condenser shells of this I-R condenser are directly connected to the dual side exhausts of the cross-compound 191,000-kw steam-turbine.



AXIAL-EXHAUST TURBINE

Connecting directly to the exhaust of an axial flow exhaust turbine, this condenser of the single-pass rectangular type represents an outstanding example of I-R adaptability.

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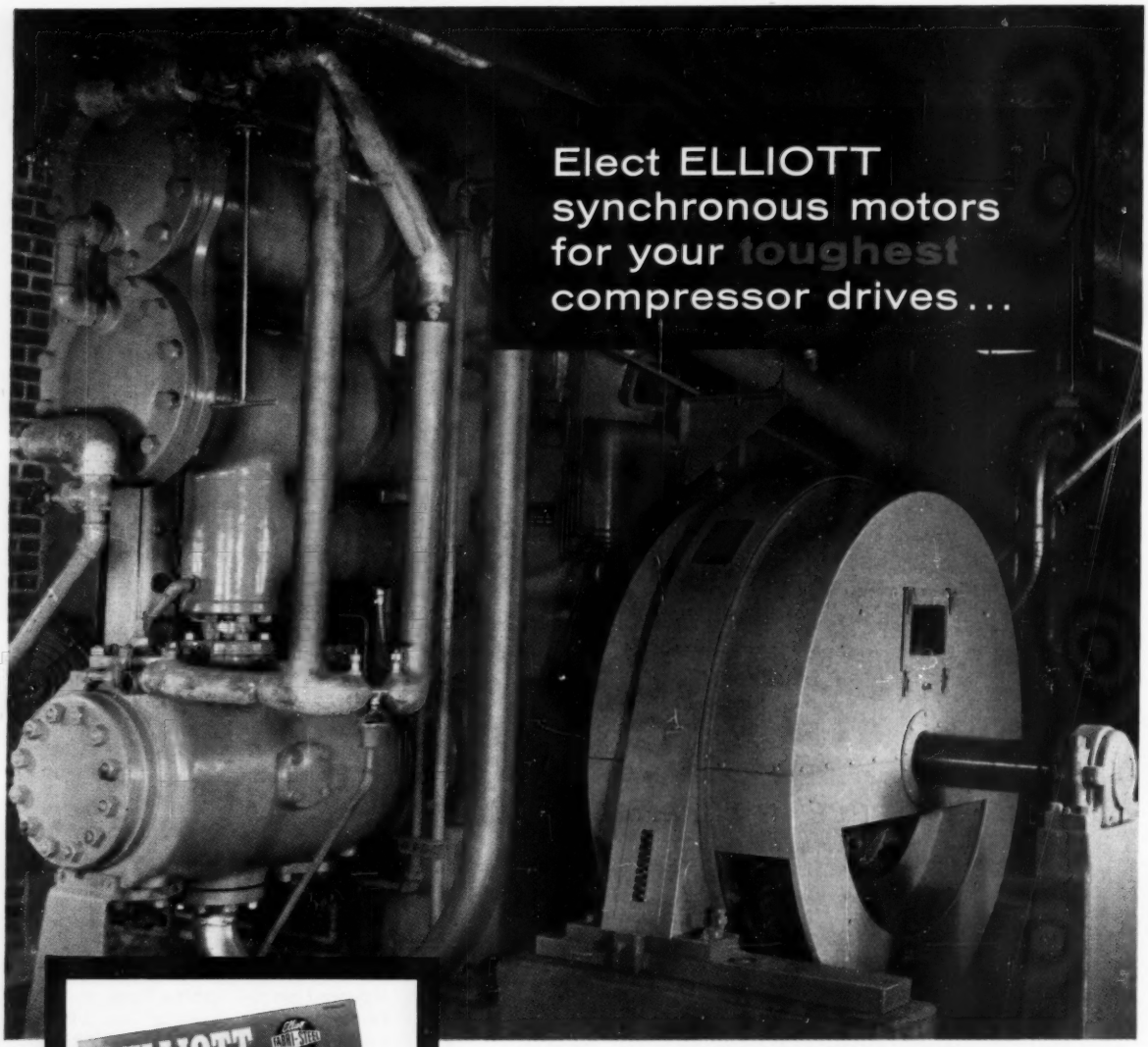

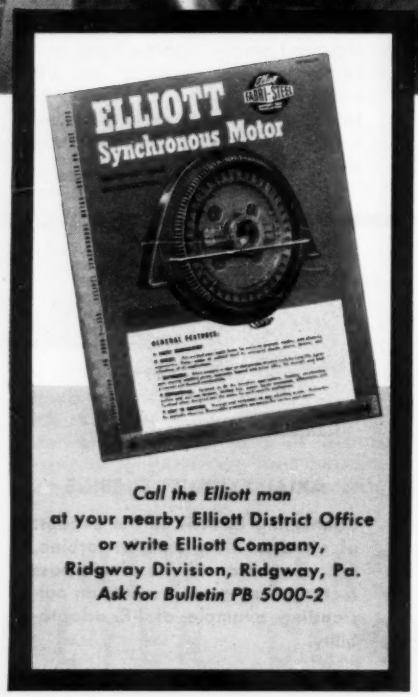

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Ask for Bulletin PB 5000-2

They're "tailored" to fit your specific application requirements

This Elliott 400-hp, 327-rpm synchronous motor is one of two machines which drives soot blower compressors for a large midwest utility generating station. Here is another example of Elliott-engineered large motors handling "tough" compressor drives *with the greatest economy and long-term, superior performance.*

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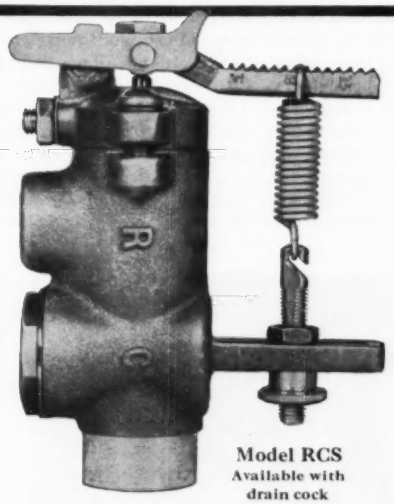

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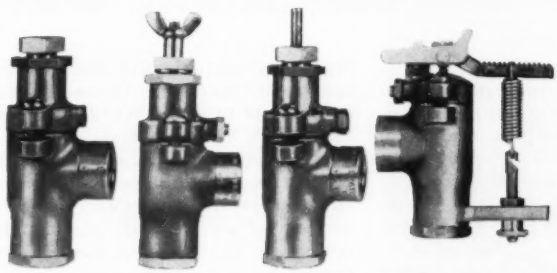

Model RCW | Model RCM-A with hand unloader | Model RCM-A | Model RCF

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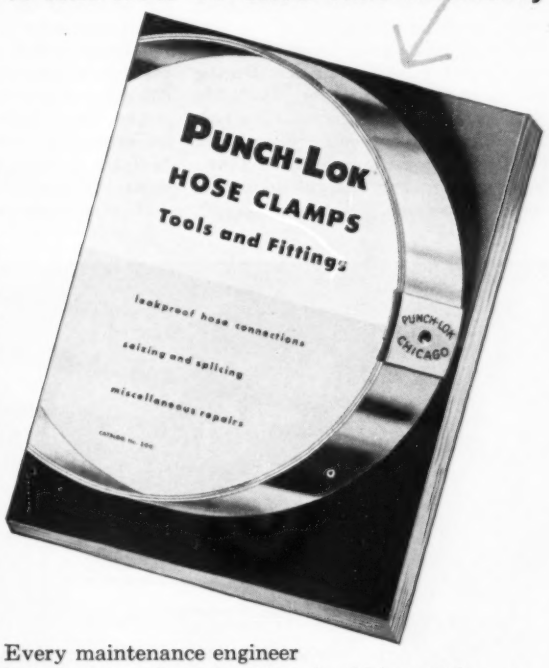

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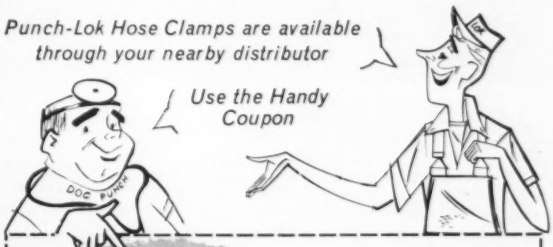

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A UTILITY that operates in a populous and rapidly growing territory is never static. Facilities that are adequate today won't meet tomorrow's needs and consequently must be improved periodically. By way of illustration, Southern California Gas Company, which serves an area that contains 5,400,000 residents and gains the population equivalent of a Pittsburgh every 4 years, has to move fast to keep up with service demands.

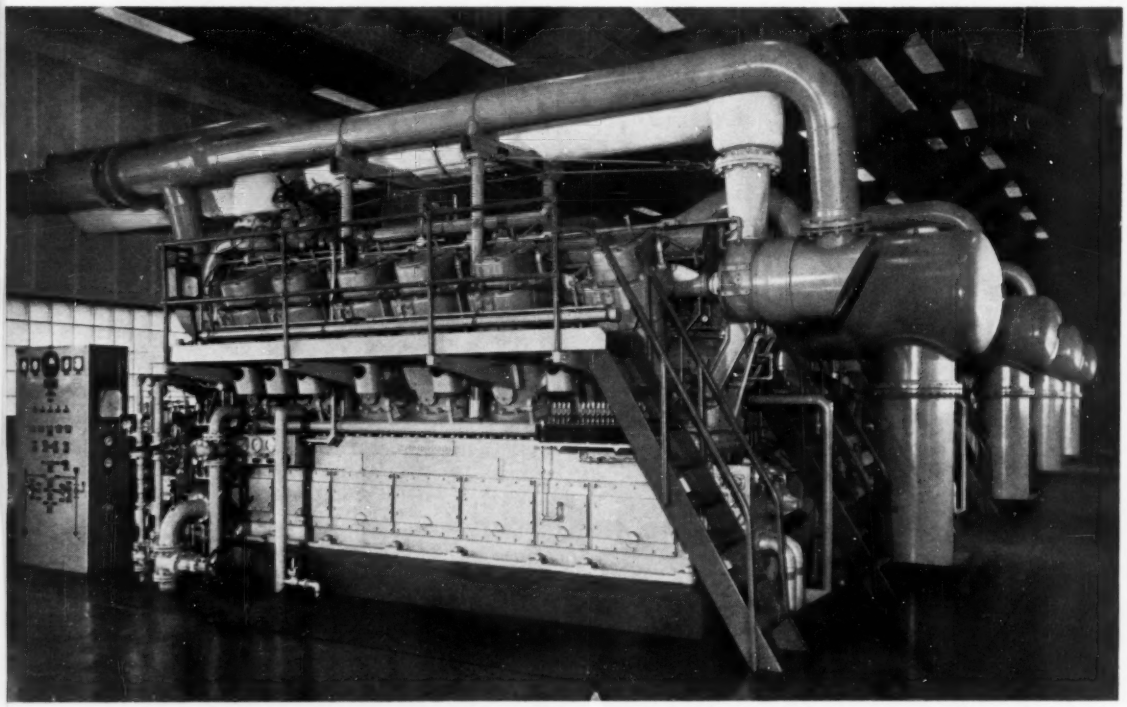
The company ranks among the nation's largest public utilities. During 1956, it served more than 1,500,000 meters in the central and southern portions of California. Total revenues and other income for the year were $162,599,000. Operating charges and other income deductions were $146,768,000, which included $68,100,000 for cost of gas purchased and more than $26,800,000 for taxes. Net income was $15,831,000. During the year the company spent $41,803,000 for improvement and expansion of its system, bringing the total value of plant properties to $418,265,000. For the tenth consecutive year, such expenditures exceeded $25 million. The 1956 outlay included $20,527,000 for additions to, and replacements of, the distribution pipeline system, about two-thirds of this work being required to take care of additional customers. Nearly 600 miles of new distribution mains were put in. More than $17 million was spent for expanding transmission and storage facilities to meet growing load requirements. Expenditures for land, buildings and other general and miscellaneous plant purposes were above $4 million.

As one phase of the program, approximately $4,500,000 was spent to modernize the Ducommun Street Station in downtown Los Angeles. Most of the station was rebuilt and nine massive, horizontal, outmoded steam-driven compressors were replaced by eight modern, compact gas-engine-driven units that require virtually no attendance. This made it possible to scrap twenty-two 500- to 1000-hp boilers, thereby conserving much space and reducing operating labor costs substantially. At the same time, the station's send-out pressure was increased from 60 to 80 psi and the hourly send-out capacity from 4 million cubic feet to 5½ million cubic feet.

To show how the revamped Ducommun Station fits into the over-all gas-distribution pattern, it is desirable to sketch in some of the system's background. Southern California Gas Company, or SoCal, to use its abridged name, is one of two distributing subsidiaries of Pacific Lighting Corporation. The other is Southern Counties Gas Company of California. Between them they distribute most of the gas consumed in the southern part of the state—SoCal roughly 70 percent and its affiliate, 30 percent. A third subsidiary, Pacific Lighting Gas Supply Company, transmits and stores natural gas and sells the two distributors some of their supply.

The phenomenal population and industrial surge that has made it difficult to keep gas-serving facilities abreast of the demand started many years ago, but has speeded up during the past 15 years or so. Prior to World War II, Southern California's chief population magnets were climate, agricultural resources, oil production and the lure of Hollywood. In recent years, the economy has taken on more of an industrial aspect and is now based principally on aircraft, electronics and automobile manufacture and television, petroleum and agriculture.

With this growth, the demand for heat energy has increased enormously. Because no coal and only limited quantities of oil are used, the gas utilities have had to supply the major portion of it. How well they have succeeded is seen in the fact that approximately two-thirds



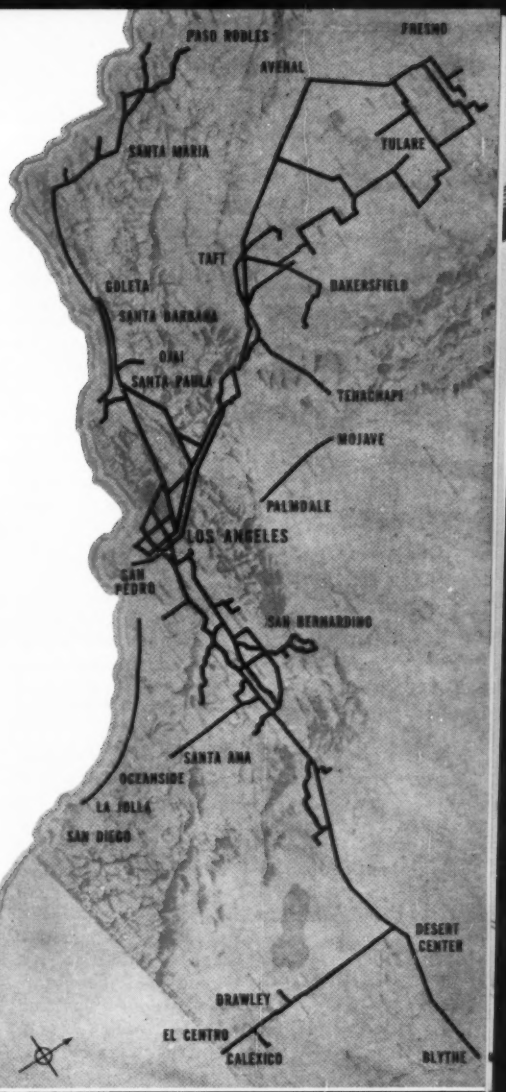
ONE END OF NEW COMPRESSOR BUILDING

Four of the eight Ingersoll-Rand Type KVS, 2000-hp, turbocharged, gas-engine-driven compressors in the revamped Ducommun Station in Los Angeles. This view of the engine side shows six of the power cylinders at the top of the near unit. They form V's with companion cylinders that are not visible. On the opposite side of the unit and hidden from view are four horizontal compression cylinders—three low-pressure and one high-pressure. Each machine has capacity to compress 750,000 cubic feet of gas an hour from atmospheric pressure to 60-85 psi. Each unit has its own control panel, visible at the left end. Unless the lubricating oil pressure, circulating water temperature and certain other conditions are normal, the engine will not operate.

SAVING BY *MODERNIZING*

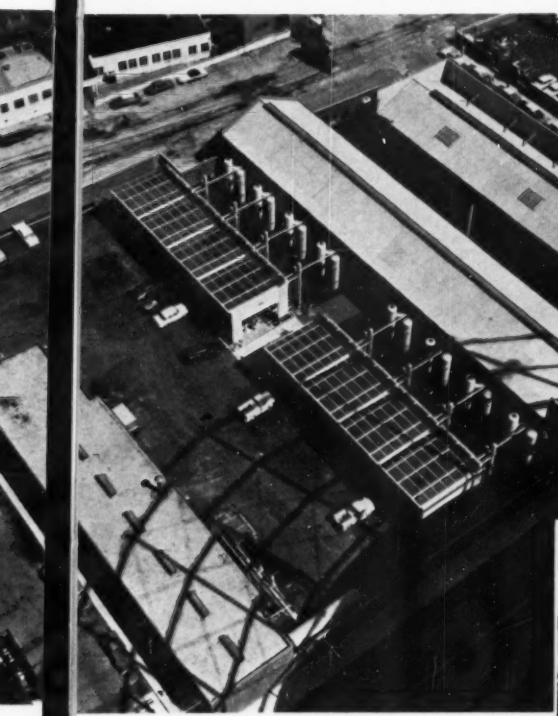
Southern California Gas Company Gains by Replacing Huge Compressors of the Twenties with Smaller Units

C. H. VIVIAN



SYSTEM NETWORK

Interconnected pipelines of the Southern California Gas Company, Southern Counties Gas Company and the Pacific Lighting Gas Supply Company. They reach more than 400 communities and supply some 6,100,000 residents of the area and thousands of industrial and commercial establishments with natural gas.



DUCOMMUN STATION— BEFORE AND AFTER

Old and new stations, viewed from the top of a gas holder, showing how the change from steam to natural gas as a medium of compressor power reduced the size of the plant. The old boiler house and the sixteen stacks that rose from it, (right) as well as some of the adjoining buildings containing auxiliary equipment, are no longer needed. The new plant, which has a greater capacity than its predecessor, is housed in the structures shown above. The auxiliaries building is at the lower left. Next to it, with cross-hatched roof, is the structure containing the cooling equipment that serves the gas-engine-driven compressors housed in the adjoining building. The metering building is at the upper right.

of the heat-energy requirements are now being met by natural gas. Its uses in-include the heating of homes, buildings and water, cooking, carrying on industrial processes and generating electricity.

Partly, no doubt, because of vigorous sales efforts by the gas companies, the area is more "gas conscious" than most sections of America. In Southern California, gas ranges outsell electric units 8.4 to 1 as compared with a ratio of 1.6 to 1 nationally. The local score on clothes driers is 1.3 to 1 in favor of the gas type versus 0.4 to 1 over the whole country, while gas water heaters outsell electric models 73 to 1 as against 3.3 to 1 on a national scale. In new homes built in 1956 in the area the company serves, 90.3 percent of the ranges, 99.6 percent of the water heaters, 5.0 percent of the refrigerators, about 66 percent of the clothes driers and 99.9 percent of the space heating units are gas-operated. This popularity of gas appliances among home builders attains added significance when it is reflected that SoCal has gained an average of more than 60,000 customers each year since 1950.

Southern California Gas Company represents the acquistion and merging of more than 60 predecessor concerns. The first of them, Los Angeles Gas Company, was incorporated June 28, 1867, and began operating late in the same year. Los Angeles had then been under American control for only 20 years and incorporated only 15 years. It had around 5000 residents, many of whom did not speak English. Homes had theretofore been lighted by tallow candles. Coal and wood, mainly the latter, were the only fuels. No gas, electricity or telephone service, no street cars or outside railroad connections existed. The backers of the original gas company plainly took considerable financial risk and had to overcome numerous obstacles.

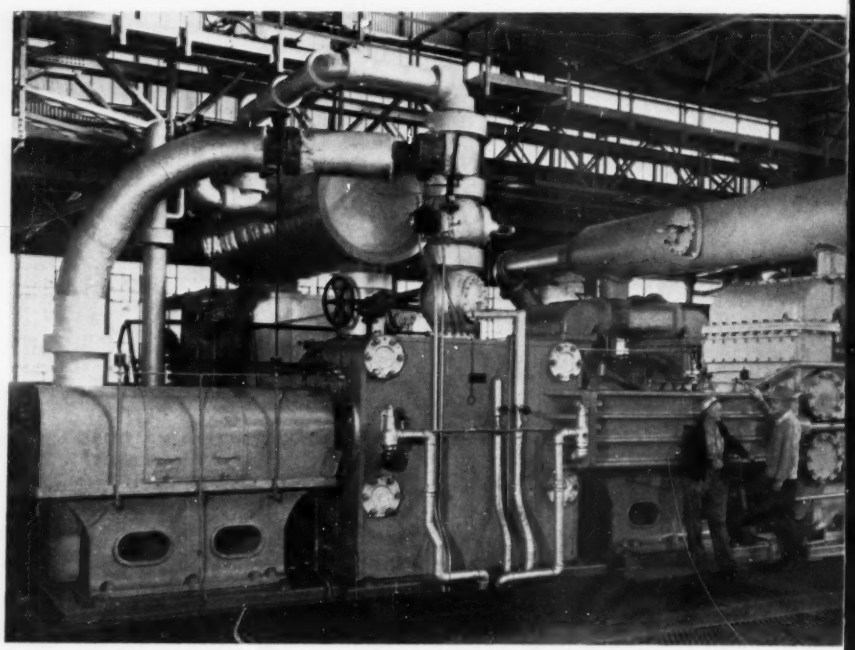
The first gas was made from coal transported from Australia. When a shipment was delayed, anything that would burn was substituted. The gas was used solely for lighting and had no Btu rating, candlepower being the only standard of lighting then recognized.

In 1882, the Los Angeles Electric Company was formed and originally furnished current for only two street lamps, one at Main and Commercial and the other at First and Hill. Seven years later the Los Angeles Lighting Company came into existence and took over the properties of the Los Angeles Gas Company and another small gas company that had meanwhile been organized. In 1904, that concern and the Los Angeles Electric Company were combined into the Los Angeles Gas & Electric Company which, in 1909, united with the Pasadena Consolidated Gas Company to form the Los Angeles Gas & Electric Corporation.

In 1910, the Southern California Gas Company was organized and a year later the Midway Gas Company was created to build a pipeline to transmit natural gas to the Los Angeles area from oilfields near Taft, to the north. SoCal took over Midway in 1927 and the gas properties of Los Angeles Gas & Electric Corporation in 1937. Meanwhile, the Pacific Lighting Corporation had acquired control of SoCal.

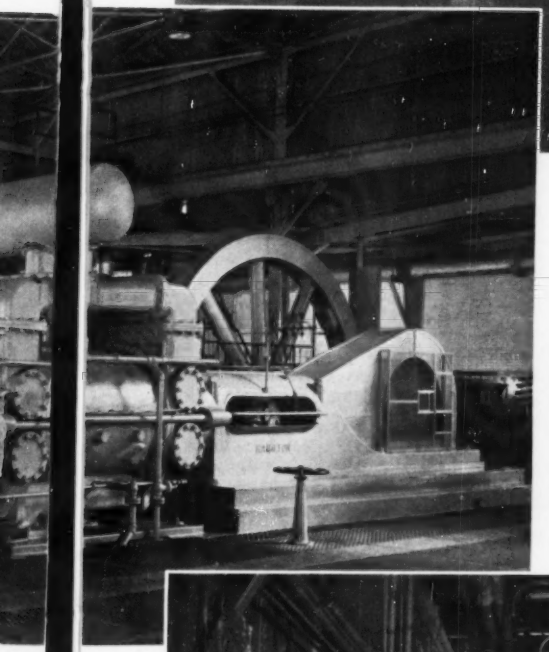
Most important among other concerns absorbed by SoCal were the Imperial Valley properties of Coast Counties Gas & Electric Company, the Indio Gas Company and the Blythe Gas Company. Natural gas became available in the Los Angeles area in 1913 and was at first mixed with manufactured gas. In 1927, the supply having become more plentiful, SoCal changed over to straight natural gas. All of it was formerly obtained from the California oilfields, but as the demand mounted it eventually became necessary to go farther afield for the necessary gas.

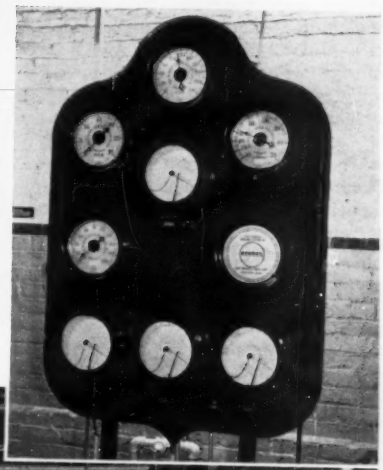
The greater part of the gas now comes from Texas and New Mexico—as far as 1200 miles away—and in the near future some will likely be arriving from western Canada, 2200 miles distant. From 1913, when Los Angeles got its first natural gas from the San Joaquin Valley, until 1947 the California fields met the needs. However, with the continued growth of the Southern California area it became evident that additional sources would be required. In 1947, a 210-mile-long, 30-inch-diameter pipeline was built by SoCal and Southern Counties to deliver gas from Blythe, on the California-Arizona boundary, at which point it is received from El Paso Natural Gas Company. A duplicate, parallel line went into service in 1954 and in August 1957, a 30-inch line from Needles, Calif., was put in operation to relay more gas from the El Paso system. Plans are also well advanced for the construction by El Paso Natural of a line that will extend from Twin Falls, Ida., where it will connect with Pacific Northwest's Canadian line, to a point on the California-Nevada border south of Las Vegas. Some of this gas, or its equivalent from Texas taken in trade for it, will likely reach Southern California, and it appears that SoCal's out-of-state receipts will reach 1230 million cubic feet daily within 3 years.

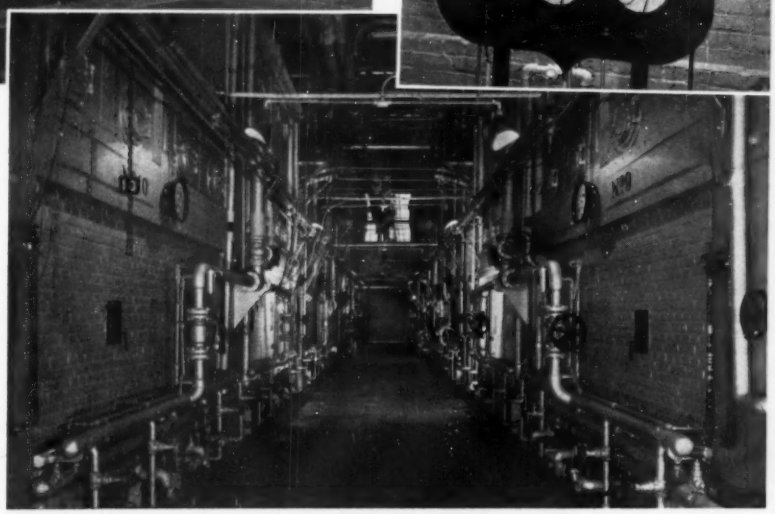


Besides the imported gas, SoCal can draw 430 million cubic feet daily from Californian sources. In an emergency, an additional 225 million cubic feet can be obtained. The latter is gas that is produced with oil but normally reinjected into the ground to maintain reservoir pressure. Agreements with producers permit taking some or all of this gas when it is needed for home heating. The average daily SoCal and Southern Counties send-out is a little more than a billion cubic feet, but an all-time high of 1.977 billion was established January 29, 1957, when snow fell in the neighboring mountains at elevations as low as 2000 feet and sent temperatures plummeting far below normal throughout Southern California.

Even all of the sources just mentioned will not yield enough gas to meet network needs during peak consumption periods. The deficit is made up by withdrawing gas from reserves that are stored when the demand is less. There







PONDEROUS EQUIPMENT THAT WAS REPLACED

Each of the nine Hamilton Corliss 2780-hp compressors removed, weighed 343 tons, 37½ tons of which was accounted for by the 20-foot-diameter flywheel with a 16-inch face. The figures in the pictures give a good size comparison. Each unit had a 72x60-inch and a 30x60-inch steam cylinder and two single-stage compression cylinders, each 33 inches in diameter and of 60-inch stroke. Each compressor had its own instrument panel (center, right). Some of the 22 boilers required to supply operating steam are pictured above.

are two types of storage facilities: above-ground metal holders and natural underground reservoirs. Holders have been used by the gas industry throughout its history and are familiar to all urban residents. They play an important part in SoCal's low-pressure storage, while natural subsurface earth spaces handle the high-pressure phase.

SoCal has one underground reservoir of its own (Playa del Rey) and Pacific Lighting Gas Supply Company has three others. The use of the Playa del Rey facilities dates from 1942 when the huge wartime industrialization created unexpected supply problems for the gas companies. Two California agencies—the Public Utilities Commission and the Department of Natural Resources—then ordered a study made of potential underground storage sites in the region. A portion of the Playa del Rey field, a partly depleted oil reservoir southwest of Los Angeles, was found to be a suitable container and was put under the control of the Federal Government and operated by SoCal.

The gas company purchased the property in 1954 and immediately began enlarging and modernizing the facilities. The field now has a working storage capacity of 1.5 billion cubic feet of gas, equivalent to the contents of 150 large above-ground holders, and represents expenditures of more than $11 million. Compressors totaling 6220 horsepower can inject gas at up to 1350-psi pressure at the rate of 100 million cubic feet daily, and by merely opening valves at the wells, 20 million cubic feet an hour can be withdrawn. Two pipelines, a 16- and a 30-inch, connect the field with the integrated network of transmission lines of SoCal and Southern Counties.

In operation, gas is injected into the reservoir each fall fast enough to reach a

usable surface pressure by November 1. Gas is thereafter withdrawn throughout the winter as needed to meet morning and evening peak demands. During the late night lull and on week-ends, when the industrial uses of gas drop, more gas is injected to maintain the desired reservoir pressure. When gas consumption falls off in the spring, injection stops and the reservoir pressure is lowered as late withdrawals are made. During the summer the field may be used for daily load equation, but the hourly volumes needed are low and a low field pressure suffices.

The largest of the three subterranean storage facilities developed by Pacific Lighting Gas Supply, is at Goleta, near Santa Barbara, roughly 100 miles north of Los Angeles. Its working capacity exceeds 12 billion cubic feet. At such a great distance, it cannot be used to meet hour-to-hour variations in demand and is consequently called on to equalize differences from day to day or over longer periods.

At East Whittier, in the Los Angeles area, is a field with a working capacity of 1.4 billion cubic feet that can supply up to 50 million cubic feet a day for meeting hourly peak demands. In the same category is West Montebello Field, in East Los Angeles, which was recently prepared for service. When fully developed, it will have a working capacity equal to that of the Goleta reservoir, with maximum injection and withdrawal rates of 65 and 200 million cubic feet a day, respectively.

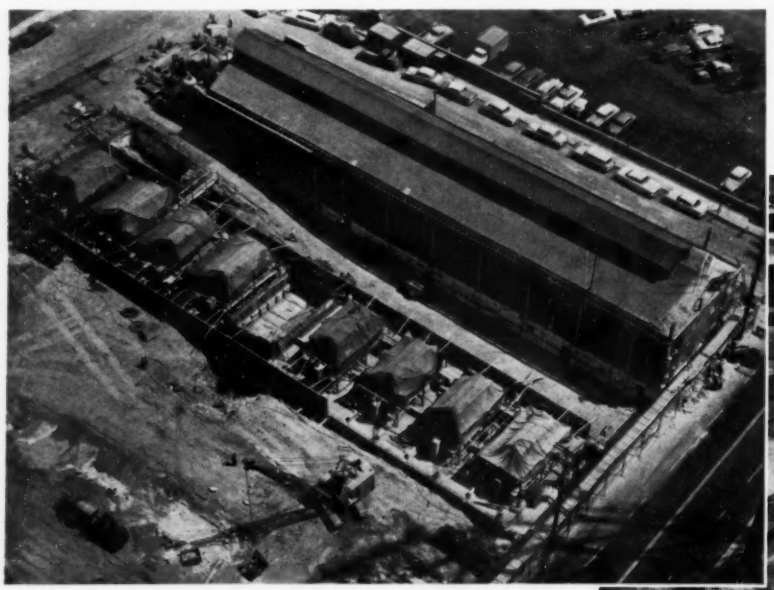
Gas fed from field lines and underground storage enters a loop of 30-inch pipe approximately 80 miles long that encloses a substantial proportion of the Los Angeles Basin that SoCal serves. This loop carries a maximum pressure of 465 psi and constitutes, in itself, a storage reservoir of considerable size. It feeds gas, at innumerable points, through reducing and measuring stations, to distribution mains and these, in turn, supply smaller mains until finally the gas, after further pressure reductions, enters the service lines on the premises of customers. There are approximately 73 million feet (13,800 miles) of distribution mains and 90 million feet (17,000 miles) of service lines.

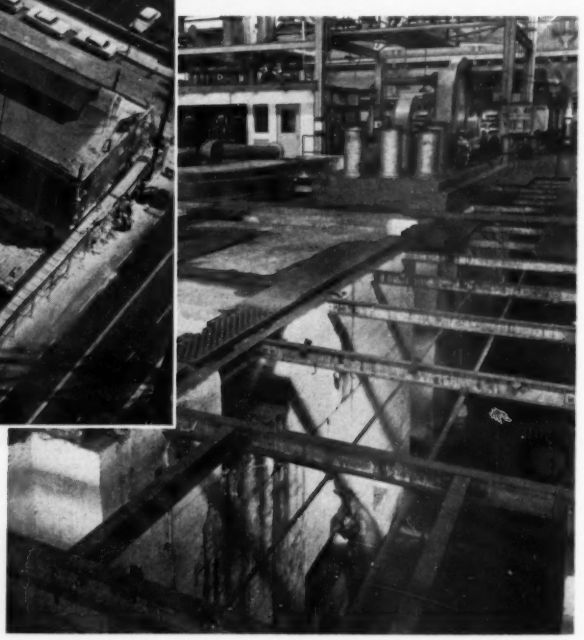
Hour-to-hour variations in demand are taken care of largely by above-ground holders and local underground storage facilities, which are alternately filled and drawn upon as the diurnal conditions may warrant. Above-ground holders in the Los Angeles Basin aggregate almost 100 million cubic feet of storage capacity at around 10 inches of water pressure. These are located at eight stations which include compressors for sending out gas or transferring it to other stations for further compression. These stations have total compressor capacity of 29,625 hp, of which 27,500 horsepower is in reciprocating units that discharge at 60- to 90-psi pressure, and 2125 horsepower is in centrifugal units that discharge at pressures up to 6 psi.

About 45 percent of the above-ground storage capacity is in five holders at the Ducommun Station. The largest of these is a 15-million-cubic-foot oil-sealed vessel 370 feet high and 288 feet in diameter. Its 280-foot-diameter piston weighs 650,000 pounds and rises or descends in operation, floating on the stored gas. The four other holders, of the water-seal type, have capacities of 10, 10, 6 and 5 million cubic feet.

The changes made at Ducommun Station mark the passing of an era of ponderous, slow-moving machinery. The nine old engine-compressors that were removed, usually designated as Hamilton Corliss units, were built by the Hooven-Owens-Rentschler Company, of Hamilton, Ohio. One was installed in 1913, one in 1921, two in 1922, three in 1923 and one each in 1924 and 1925. They were sold to the gas company by C. C. Moore, local representative of Babcock & Wilcox Company, which supplied the twenty-two 500- to 1000-hp boilers eventually required to furnish steam, and assisted in designing the plant. Compound steam cylinders were 36 and 72 inches in diameter, single-stage compression cylinders were 33 inches in diameter and all were of 60-inch stroke. The machines operated at 60 rpm and, when discharging at 60-psi pressure, developed 2780 horsepower each. The flywheel of each unit was 20 feet in diameter, 16 inches across the face and weighed 75,000 pounds. The remainder of each unit weighed 611,000 pounds

Charles Wilcox, who ran the station for years, has old books that show a pay-



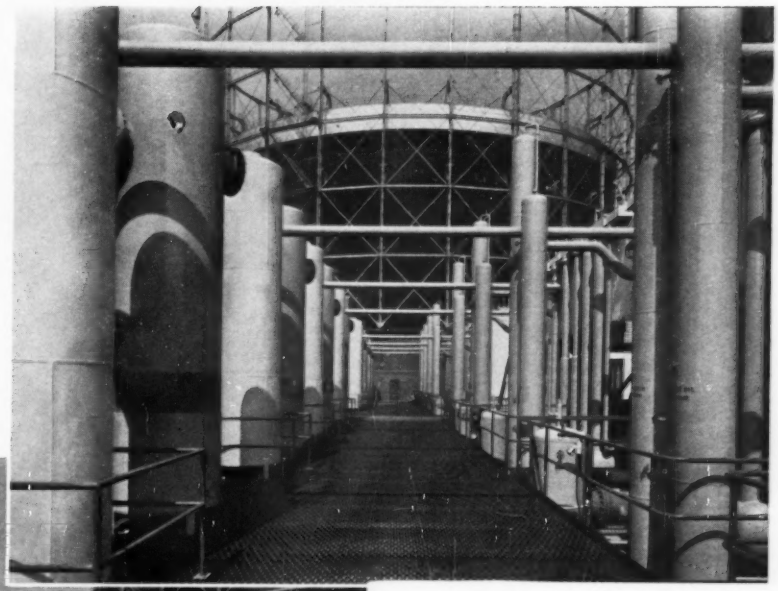


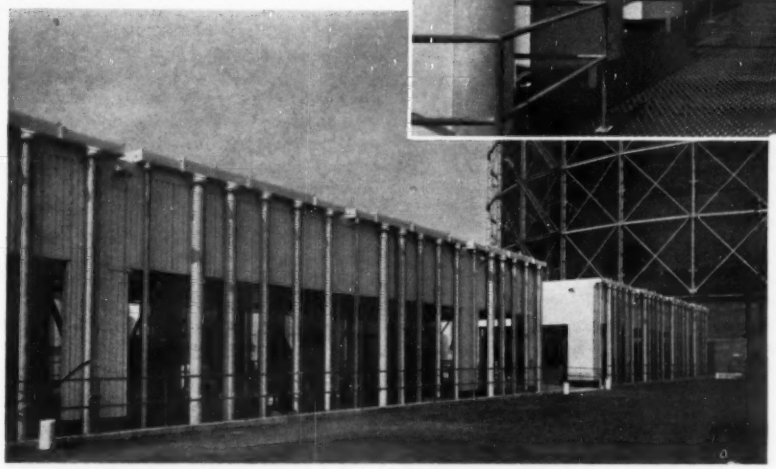
DEMOLITION AND CONSTRUCTION

The view at the right shows one of the massive and deep foundations from which one of the old steam-driven compressors was removed. The other picture shows the new gas-engine-driven units covered by tarpaulins. They were erected in the open and the building was put up around them later.

AUXILIARY EQUIPMENT

Although the designing engineers were thinking primarily of utility, they also achieved an artistic effect here. Looking along the corridor at the right, intake filters and exhaust mufflers of the compressors alternate at the left, while the edges of the Fin-Fan coolers are on the right. The other picture shows the coolers from the opposite side. Air blown upward through coils in the overhead sections cools the gas after the first and final stages of compression, as well as the compressor and engine lubricating oil and circulating water. The gas holder in the background of both views is the largest in Los Angeles. It is 370 feet high, 288 feet in diameter and can hold 15 million cubic feet of gas.





roll of 114 persons in 1925. Included were 16 engineers and 35 oilers assigned to the compressors and 16 oilers for the auxiliaries. Seven "pressuremen" manipulated hand valves to adjust the send-out in conformance with sectional demands. In striking contrast, the station now runs with two compressor attendants and a foreman on each shift.

The "pressuremen" have been replaced by an automatic metering station where gas received from the out-of-state transmission system and reduced to around 80-psi pressure is mixed with gas from the Ducommun compressors at a like pressure. Although operating conditions vary with the demand, gas from the pipeline may be coming in at a rate of say 4½ million cubic feet an hour and it is desired to send out 10 million cubic feet an hour. This means that the Ducommun compressors will deliver 5½ million cubic feet an hour. The Ducommun Station, then, serves essentially as a regulating medium.

During World War II, the old compressors had a part in the manufacture of rubber of the styrene type for the Government. Butadiene gas, essential to the process, was produced by thermally cracking natural gas. Wet gas, taken from a holder, was compressed by four Ducommun units from ½- to 50-psi pressure and sent to other compressors at the Jackson Street Station that boosted it to 200 psi, at which pressure it was run through an absorption plant. The condensed and liquefied gas was pumped to a Shell Chemical Company plant at Torrance for purification and then distributed to the rubber companies for conversion into the final product.

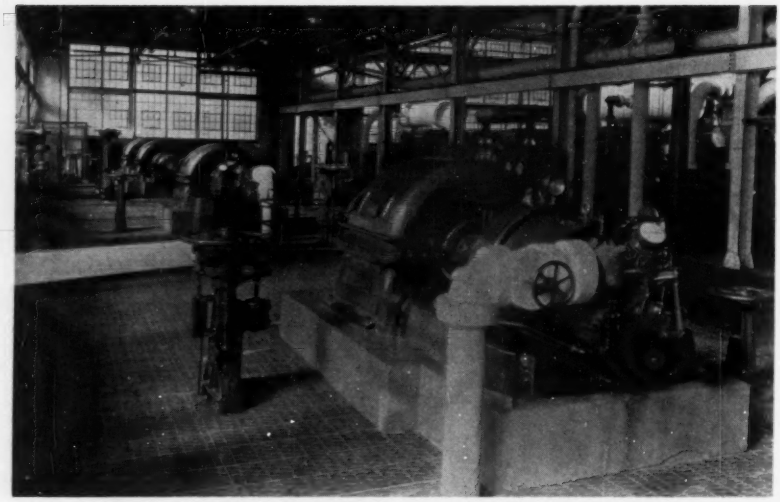
The eight new Ingersoll-Rand engine-compressors are designated as Type 412 KVS-2 heavy-duty, direct-connected, turbocharged, 4-cycle, 2-stage, gas-engine-driven units and are similar to those in service on some of the nation's leading high-pressure gas transmission systems. Each has a 12-cylinder (15¼ x 18-inch) V-type engine that drives four horizontal compression cylinders—three low pressure ones (34½x15-inch) and a single (32x15-inch) high-pressure one. Each machine is rated at 2000 hp and is designed to compress 750,000 cubic feet of gas an hour from atmospheric pressure to 60-85 psi.

The turbocharging, which increases the power by raising the volume of oxygen delivered to the engine combustion chambers, is handled by two Elliott centrifugal blowers on each unit. One is mounted at either end of the engine and they discharge into a common inlet manifold at 4-psi pressure. Each blower is direct-connected to a turbine that is driven by exhaust gas from the adjacent six cylinders, thus utilizing normally wasted pressure and velocity energy from the exhaust.

Each compressor operates independently of the others and has its own control panel that provides for push-button starting and stopping. Unless lubricating oil pressure and temperature, cylinder jacket water temperatures and other conditions subject to control are normal, the engine will not operate. Central control of all units would have involved the risk of nonfunctioning of the entire plant in the event of control failure—an almost impossible occurrence under the unitized arrangement.

Any or all of the units can be started within 5 minutes. In the auxiliaries building is a Rite boiler, fired by natural gas, that keeps enough jacket water at 140°F, the prescribed temperature for the power ends, to supply all the machines. On each engine, also, is an air-motor-driven, lubricating oil pump that quickly brings the oil pressure up to the operating point.

The compressors are in line in their own building, which is flanked on one side by a row of Fluor Fin-Fan heat exchangers containing eight sections—one for each machine. In each section are four nests of elevated horizontal tubes—one each for intercooling and after-cooling the gas, a third for cooling engine jacket-circulating water and the fourth for cooling compressor jacket-circulating water (the last mentioned circuit first cools the lubricating oil and then the compressor cylinders). Cooling



CENTRIFUGAL COMPRESSORS

These four Ingersoll-Rand turboblowers formerly took gas from above-ground holders at Ducommun Station and discharged it into low-pressure distribution lines. They were driven by steam turbines, and their capacities ranged around 1 million cubic feet per hour. The first one was placed in service in 1919, and the others were added, one at a time, from then until 1926. Although no longer needed under the new station arrangement, some of the machines have been transferred to other system locations and are still operating.

in each section is accomplished with the aid of a 6-bladed fan, 16 feet in diameter, mounted underneath the tube nests and operated by fluid drive. The fluid, put under pressure by a Berry pump that is direct-connected to the flywheel end of the main shaft of each compressor, is piped to the exchanger and there operates a Berry motor that turns the fan shaft through a right-angle gear. By manual control, some of the fluid may be made to bypass the driving motor, thereby reducing the fan speed, When an engine-compressor is started, the Fin-Fan section that serves it begins to function immediately.

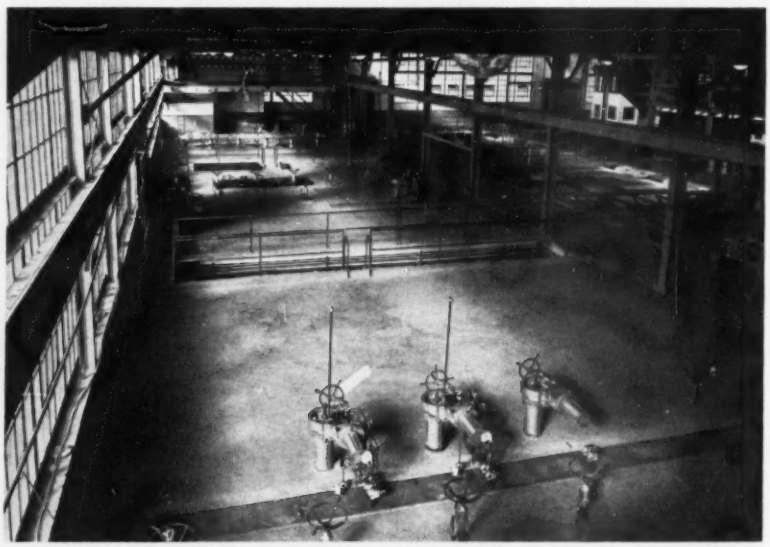
A 60-inch suction header delivers gas from any of the holders and from it 30-inch lines run to each compressor. The compressor discharge header is 26 inches in diameter. As a safety precaution, motor-operated valves can bleed the entire plant system down and discharge the gas through a stack in 45 seconds, and this can be done from any one of several remote locations.

When more gas is needed than the Ducommun holders can supply, it can be obtained from holders at Macy Street and/or Seventh Street. An Ingersoll-Rand turboblower at each place can transfer it to Ducommun at a rate of 1 million cubic feet an hour. These blowers and two others were formerly installed at Ducommun Street and used for sending out gas at 3-psi pressure.

To insure the quietness that is desirable in deference to neighboring tenants and passersby, the compressor building is constructed to absorb noise and each engine-compressor is served by a Burgess-Manning intake filter and exhaust silencer. Each compressor is equipped with pulsation dampeners, to smooth out the intermittent surges arising from the reciprocating action, and volume bottles, to reduce frictional resistance that hastens fatigue failure of piping.

Compressed air for starting the main engines and other purposes is supplied by Ingersoll-Rand compressors in the auxiliaries building, which also houses other machinery, a small workshop and a locker and change room for employees. A Class PHE 12½x7¾x6-inch compressor driven by a direct-connected 100-hp motor furnishes general plant and shop air at 125-psi pressure and some of it is reduced in pressure to provide instrument-operating air. Another portion of the discharge goes to a Class ES-1 3x7-inch booster that raises its pressure to 250 psi. This air is stored in a large receiver and used for engine starting. For use in case of a power failure, there is a Type 40 compressor driven by a Waukesha industrial-type engine that runs on natural gas. There is also an emergency Delco 75-kw generating unit driven by a similar Waukesha engine that starts automatically within seconds to provide current for operating plant valves and provide minimum lights.

Guy T. Martin & Co., handled the engineering and Macco Corporation the construction of the new station. Allison & Rible served as architectural consultants. Macco also razed the old station and demolished the massive foundations under the old steam-driven compressors. All are Los Angeles firms.



METERING EQUIPMENT

All of the gas sent out by Ducommun Station during hours of low consumption is normally taken from high-pressure transmission lines from Texas and reduced to the distribution pressure. During peak demand periods additional gas has to be provided and is taken from storage and brought up to send-out pressure of approximately 80 psi by the KVS compressors. As many of the the eight units as may be required can be put into service quickly. The hydraulic valves shown here automatically proportion the volumes received from the two sources. Through telemetering equipment, they can be actuated by a dispatcher in another station several miles away. The instrument board at the far end of the room shows and records the station's performance. At one time the station had seven "pressuremen" to manipulate hand valves to adjust the send-out in accordance with the fluctuating sectional demand for gas.

Japanese boost industries with—

HYDRO WORKS ON THE KUROBE

D. C. Garfield

THE KUROBE'S COURSE

Although short, the Kurobe River, when fully developed, will furnish some 500,000 kw of electric energy. Its precipitous descent is apparent in this picture which shows the site of the dam now rising in mountains near Osaka.

JAPAN, a land of meagre resources, has traditionally concentrated on the development of hydraulic power. As in other countries, the demand there for electric energy is increasing rapidly. Great effort is being expended by the government and nine private, regional power companies to provide the required facilities.

The most advantageous hydraulic sites were developed before World War II. Post war projects, on the other hand, have been comparatively more difficult and have required extensive investment. Consequently, recent years have also seen the introduction of numerous thermal power facilities. Although they have the advantages of being cheaper and quicker to build, they have a substantial drawback in that fuel must be imported, an additional expense to an already costly operation.

Probably few people outside Japan realize the extent to which her industry has advanced. This development can be gauged by comparing the 1955 monthly average of 5297 million kwh with the 1947 figure of 2461 million kwh. The United Kingdom, in 1955, averaged 6679 million kwh; West Germany, 6315 million; and France, 3897 million.

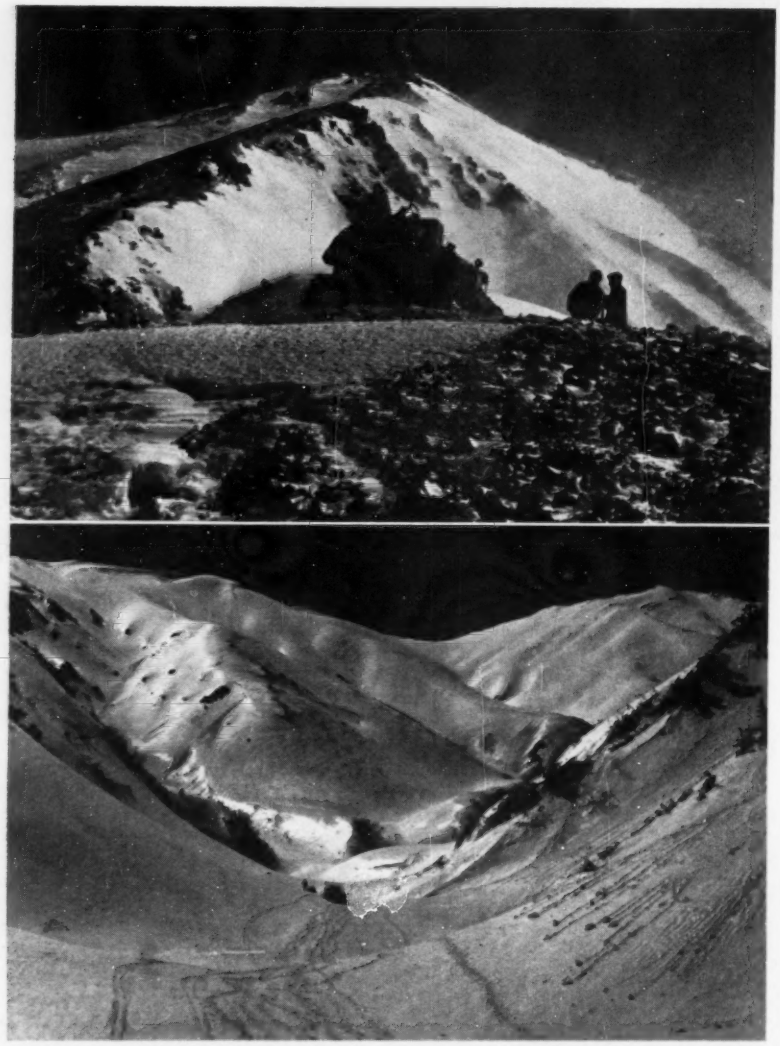
It is noteworthy that a number of thermal units, ranging from 156,000 to 265,000 kw, are under construction or on order. Basic machinery for many of them is currently being imported from the United States. Today, however, Japanese manufacturers are building units up to 200,000 kw in size, and Japan will undoubtedly supply the bulk of her own requirements in years to come.

One of the earliest Japanese industrial achievements was the construction of imposing hydroelectric power facilities including not only dams and tunnels but also water wheels, alternators and related electrical equipment. Many of these stations are in Japan, but others, including some of the largest, are in Formosa, Korea and Manchuria, parts of her former empire. Japan is now internationally prominent in the hydraulic turbine and generator field. For example, Japanese manufacturers hold contracts for several 150,000-hp machines for India's huge Bhakra Dam, and two 22,000-kva generators and a 10,000-hp water wheel for Mexico.

Hydroelectric facilities in Japan are built either by the regional power companies or by the Japan Electric Power Development Company, a government corporation. Some of the largest facilities completed since World War II, or that are substantially underway, are listed in the accompanying table. In every case, almost all installed equipment was manufactured in Japan whereas principal items of construction machinery, including power shovels, rock loaders, portable compressors and bulldozers, have often been imported, invariably from the United States.

TUNNEL ADIT

At the diversion-tunnel adit, an Ingersoll-Rand Gyro-Flo 315-cfm compressor that was packed in over the Japanese Alpines is shown supplying air for drills at work within. In the background an International Harvester tractor aids in clearing the work site.



SLEDDING

Crawler-type tractors hauled disassembled compressors as far as possible by towing them in sleds. When the terrain became impassable, men shouldered the packs for the laborious trek to the Kurobe gorge. The elevation at which these illustrations were taken is about 9000 feet. Access roads are now underway to enable other equipment to be hauled in by more conventional methods.

One of the largest hydroelectric plants now under construction is Kurobe Number IV, a station of Kansai Electric Power Company. (Kansai is the area around heavily industrialized Osaka.) Kansai Power Company is one of the two largest power producers in Japan.

The waters of the Kurobe River have been extensively harnessed. The river is short as compared to those utilized for hydroelectric purposes on large continental land masses. Its entire course is only 53 miles long, and it has a basin of but 304 square miles. The drainage area above Kurobe IV is only 80 square miles. On the other hand, the gradient is 1 in 40. It rises in Central Alpine National Park and cascades down steep mountains discharging into the Sea of Japan. The precipitation in its watershed averages 150 inches per year. Consequently, although short, the river will yield in excess of 500,000 kw after completion of the new dam.

One of the greatest hurdles to be overcome in the construction of Kurobe IV has been that of the transportation of necessary equipment to the dam site. The magnitude of the work which must go into this phase is a testimonal to the ruggedness of the terrain and inaccessability of the site. The Japanese mountains rank among the world's finest from a scenic point of view, and although they are within a few miles of the sea, often rise to 10,000 feet or more. As the river gorge is too precipitous and the water too turbulent to permit transportation of personnel, much less equipment, it was decided to construct a roadway, 16 miles long, to link the site with existing transportation facilities. It includes 3.4 miles of tunnels, averaging 15 feet in diameter.

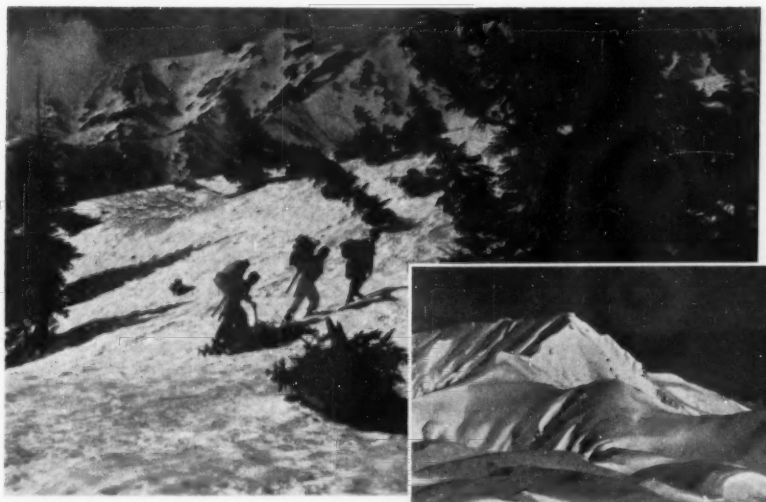
In order to begin work, the bare essentials of supplies and machinery were brought, with the greatest difficulty, to the workings. The first major units to be taken to the dam site were three Ingersoll-Rand DR-315 portable air compressors, disassembled into components that could be carried by manpower over the roughest of ground. To stay within manageable weight limits, the crankshaft, connecting rods, pistons, etc., were removed from the engine block, and the compressor end, completely disassembled.

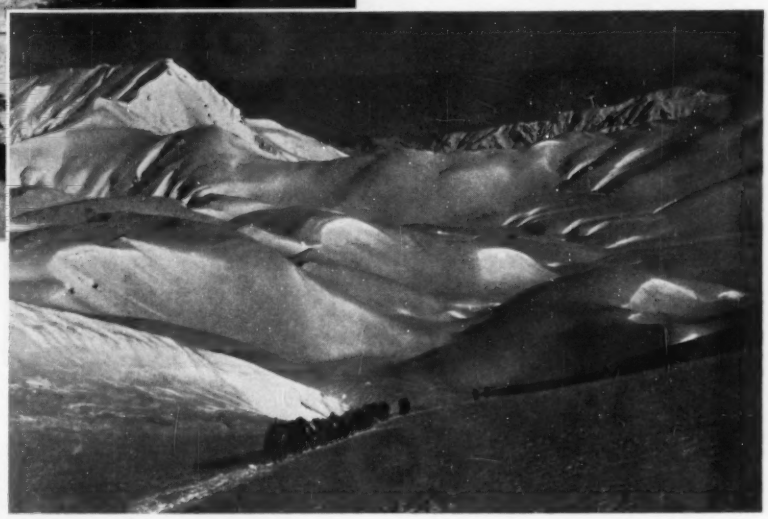
The dismantled machines were pulled on a sled over snow by a crawler-type tractor until the terrain became impassable. Then the compressor parts were packed several miles on men's backs, no small task, considering that each machine weighs approximately 6000 pounds. At the site, the machines were reassembled. It is a tribute to the ability of the mechanics and the quality of the machines that all the equipment worked smoothly. Later, six additional DR-315 Ingersoll-Rand Gyro-Flo compressors and several DR-600 and DR-900 Gyro-Flos were assigned to work at various spots on the project.

When completed the domed dam will be 610 feet high, 1240 feet long at its crest and will have a volume of about 2,100,000 cubic yards. Its available storage capacity will be slightly more than 5 billion cubic feet, and the impounded water will be delivered through a 6.1-mile-long pressure tunnel to an underground powerhouse. The effective head will be 1840 feet. Upon completion, the power station will have a maximum output of 258,000 kw with three equal-size, vertical turbines and alternators. Since both 50- and 60-cycle systems exist in Japan, the equipment will be arranged to operate at both 300 and 360 rpm.

In addition to power, another important benefit will be the stabilization of the river system. Since most of the watershed remains snow covered in winter, reservoirs behind the existing dams are drastically drawn down. The actual output obtainable from these thus may fall from a total installed capacity of 240,000 kw to 60,000 kw. Completion of Kurobe IV will increase the output of downstream plants by 267 million kwh per year, equal to about one fourth of the output of the new plant's own generators. Furthermore, most of this increment will come in the winter months when power is in shortest supply.

Because of the limited working season, operations must be halted for approximately 5 months per year during the





PACKING THEM IN

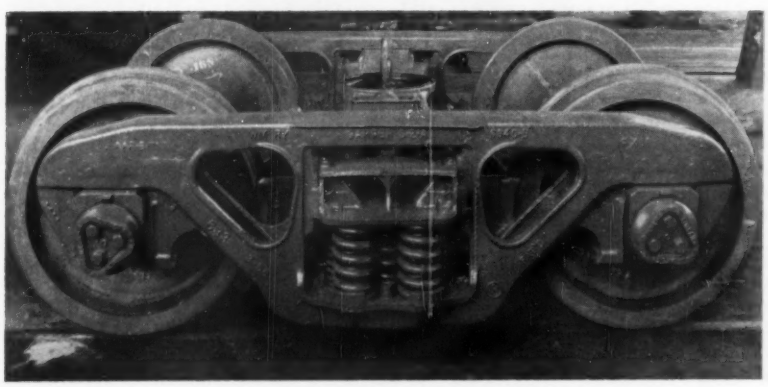
When all other forms of transportation bogged down, the Japanese workers shouldered packs containing component parts of compressors and other machines, and trudged over the snow-clad mountains. The units were reassembled at the job site and immediately put to work. Until better transportation facilities were built, all supplies came to Kurobe IV in this fashion. These photos were taken last April.

coldest weather. The full capacity of the new plant, therefore, is not expected to be available before 1961, although it is scheduled to deliver 153,000 kw by 1960. The river's flow is also expected to be fully stabilized by 1960, thus boosting the output of the already installed downstream plants.

Construction of the road and appurtenant tunnels is now well under way; it is hoped they can be completed in the near future. Work on crane facilities and a batching plant was started last September and advanced, before work had to be discontinued for the winter, to a point from which completion of these facilities, it is hoped, can be realized in 1958. Pouring may begin in 1959.

Some of the work on the surge tank and pressure tunnel has already begun but will not get underway in earnest until later this year. As with most Japanese hydro facilities of this scope, full-faced headings will be advanced by jumbos with boom-mounted drifters. The unfinished bore of the pressure tunnel and tail race will range from 18 to 20 feet in diameter, and an advance of 26 feet per day in the longest sections is planned.

Servicing *ROLLER* Freight

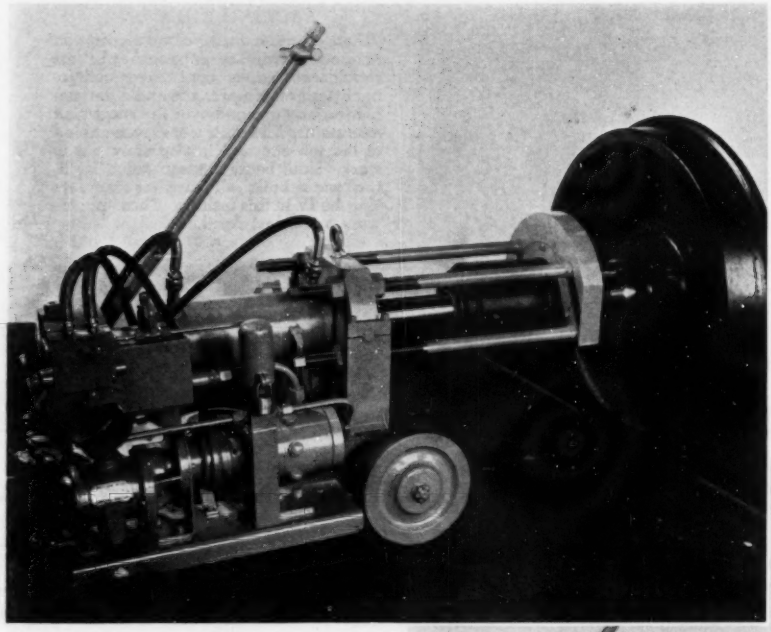


ROLLER BEARING FREIGHT CAR TRUCK

Timken Roller-bearing-equipped freight-car truck for a 70-ton hopper car. The familiar journal box and lid covering an oil-soaked wad of waste is gone. Bearings like these require inspection at only 3-year intervals.

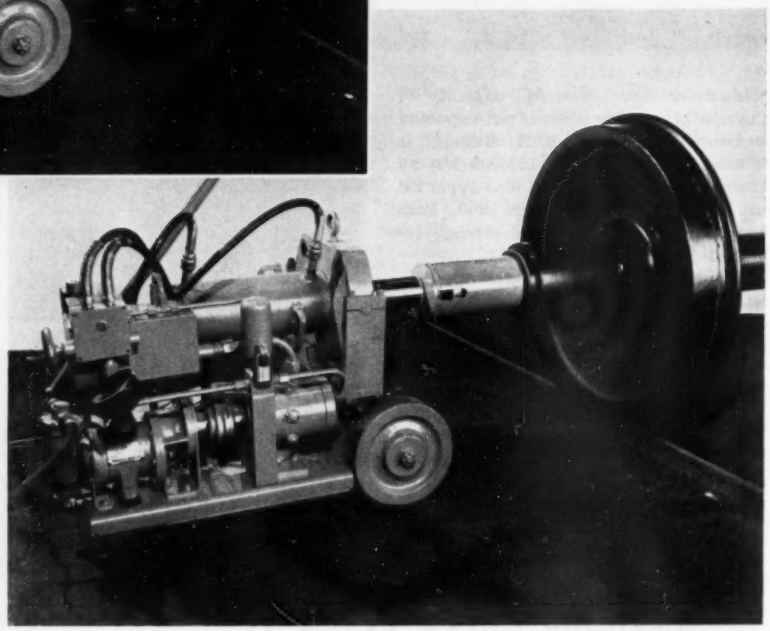
OVERHEATED journals or "hot boxes" have always been troublesome to railway freight haulers, but with the advent of diesel locomotives, the problem has become even more acute. Longer trains, faster schedules and less time available for inspection have produced more and more of the telltale wisps of smoke that signal an overheated axle. Even if detected in time, hot boxes mean delays, sidetracked cargo and expensive maintenance; when undetected, they may cause derailments and sometimes loss of life.

Hot boxes develop when bearings are improperly lubricated. Although most passenger cars are now equipped with roller bearings, the majority of freight cars still use friction-type bearings or "brasses," lubricated by oil soaked wads of waste. When this waste becomes dislodged, doesn't receive enough oil or is contaminated with water or dirt, metal-to-metal friction occurs, the journal box begins to smoke, and the result is a hot box. Railroad officials recognize this condition as one of their most serious maintenance problems.



BEARING MAINTENANCE RIG

The illustration at the left shows the wheel-bearing machine designed by The Timken Roller Bearing Company removing a roller bearing from a freight car axle. The hydraulic ram is capable of exerting up to 78 tons pressure, although removal and installation of bearings normally requires only from 8 to 60 tons. The picture below shows the unit with its puller frame removed, installing a bearing.



A number of railroads have equipped freight cars with roller bearings, although only one road, the recently completed Quebec, North Shore & Labrador, uses roller bearings exclusively. Experience seems to indicate that the answer to the hot box problem is to go "roller freight," and the changeover is regarded by many as the next major step in railroading.

Roller bearings have a number of advantages over the old friction type. They are lubricated with grease, much the same as an automobile wheel bearing, and the grease is sealed in so that it will not leak away or become contaminated. They reduce starting resistance by 88 percent and eliminate much of the starting jerk that damages fragile cargo such as tile, glass or eggs. They also reduce lubrication costs, operate more efficiently in cold weather and practically eliminate the hot box problem.

On the other hand, many obstacles must be overcome before this "next great step" in railroading is completed. The initial cost of roller bearings is higher than that of friction-type brasses. Freight cars also are transferred from one railroad to another under an interchange system and are frequently away from the parent roads for long periods of time. The railroads have hesitated, naturally, to spend more per freight car on roller bearings when other roads profit by the savings. This limitation would disappear if all lines agreed to equip new cars with roller bearings, and set up a program for the conversion of existing cars. The job is a big one, and even with agreement on all sides, could not be accomplished overnight.

A mobile, hydraulically operated device designed and built by The Timken Roller Bearing Company makes it easy and inexpensive to service cars equipped with roller bearings. The unit installs or removes a bearing in about 30 seconds without wheel removal and eliminates the necessity of tying up repair-shop wheel presses for bearing work. Previously developed bearing pullers included mechanically or electrically operated devices that required as long as 8 minutes to remove bearings.

From 8 to 60 tons of pressure are needed to exchange bearings, depending on sizes and tolerances. To supply this pressure, the device is equipped with a radial pump that delivers 1½ gallons of fluid per minute at 10,000 psi through a 4-way valve to a ram. It is powered by an Ingersoll-Rand air motor delivering 9½ hp at 100-psi air pressure. For removing a bearing, a pilot sleeve is bolted to the car axle. A puller frame equipped with the proper size pulling-shoe insert is lowered into position behind the bearing assembly and sufficient pressure is then applied by the ram to remove the bearing. When being installed, a bearing assembly is placed over the pilot sleeve after it has been bolted to the axle. An assembly sleeve is placed against the bearing and over a thrust rod operating through the ram. The thrust rod is threaded into the pilot sleeve, locking the unit to the axle. Sufficient pressure to install the bearing is then applied to the assembly sleeve by the ram.

The Timken Roller Bearing Company has built only one of these devices for applying and removing railway car axle roller bearings. This device is available on a loan basis. The company has, however, released rights for this unit to a manufacturer, and models similar to the original are now being produced.

IMPELLER TESTING

A PRECISION-cast high-speed aluminum impeller, fabricated by Aluminum Company of America's Cleveland, Ohio, Development Division, has been spun at just under three times the speed of sound. (Flying at this pace, tomorrow's jet aircraft could cover the distance between Cleveland and Pittsburgh, Pa., in less than 4 minutes.) The device is a means of obtaining proof of the quality of new alloys in high-speed rotating part applications.

Although Alcoa has been spinning aluminum components for aircraft engine superchargers, propellers, jet engine turbines and torque converters since 1944, the 2000-mile-per-hour speeds, recently attained, have not been common until lately when new high-strength alloys were developed.

In testing for strength characteristics, parts are rotated in a specially designed testing machine, or "whirl pit," until they literally fly to pieces. The pieces are reassembled, and the information they show makes possible a thorough design check to meet specific service requirements. "Non destructive" testing can also be carried on. It requires a coating of a brittle, lacquer-like substance on the part. After whirling at speeds just short of destruction, cracks in the coating present graphic proof of high-stress areas.

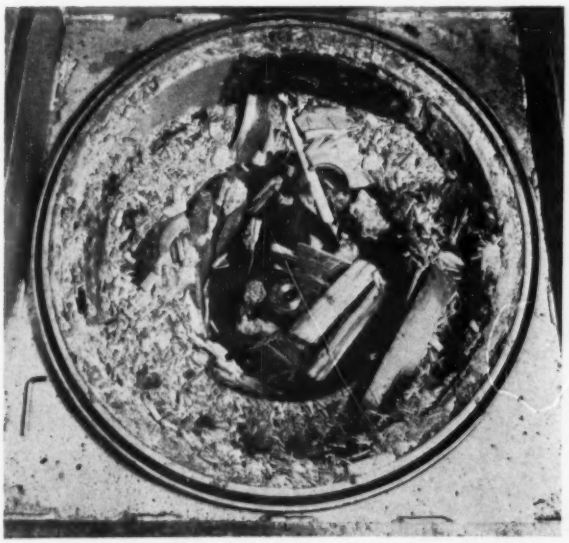
Since the construction of the spin pit in the early 1940's, more than 200 different projects have been completed. The parts investigated range in weight from less than 1 pound to more than 1600 pounds, their diameters to as much as 5 feet. Speeds exceed 100,000 rpm, and parts have been spun without rupture with peripheral velocities of 3000 fps.

Most of the investigations have been conducted with aluminum alloys fabricated by processes involving sand, permanent and semipermanent molds, plaster and die castings. Forged and aluminum-brazed parts, as well as premium strength castings, are also used.

Aluminum parts, bolted to an air-driven turbine, are spun in a vacuum so that air resistance will not impede them. Five different turbines are available to cover the range of speeds and loads of the parts under test. The maximum air pressure used is approximately 100 psi, and is drawn from the plant air-supply system.

MOUNTING BEFORE TEST

At the Cleveland Development Division of Aluminum Company of America, an impeller is mounted on a test arbor for the whirl-pit test. It will spin at a rate just under three times the speed of sound, and when it has broken into pieces, will be reconstructed.



AFTER THE TEST

Looking into the whirl pit after an impeller has been tested. The part has been spun to destruction, and can now be checked for strain and stress areas. The speed at which the failure takes place can also be accurately determined. Aluminum parts have been tested without rupture at a speed of 2045 mph.

The chamber is evacuated to a pressure of 2 or 3 mm Hg. The power requirements, due to air friction in the vacuum chamber, are directly proportional to pressure in the chamber. Thus the power requirements to rotate a given part at a given speed in an atmosphere of 3-mm Hg pressure, would be 1/250 of the power requirements at atmospheric pressure (750 mm Hg).

The turbine emits a sound comparable to that of a police siren two blocks away. As its speed increases, this noise soon fades, only to be replaced, then reinforced, by others as multiple sound waves are generated. Eventually all pass out of the range of human hearing.

The magnitude of stresses set up in a rotating part are directly proportional to the weight, or density, of the material. The lighter a rotating part is, the more responsive it is to acceleration or deceleration.

A 1-inch cube of aluminum, rotating in a circle of 1-foot diameter, at 78 rpm (normal walking pace) needs a force equal to 0.1 pound (the weight of the cube) to hold it in its path. However, as the block begins to circle faster, the force required to retain it jumps. For example, at 5000 rpm that force rises to 427 pounds. At 76,000 rpm (or 2700 miles per hour) a force equalling 100,000 pounds is required to keep the same small block in its circular path.

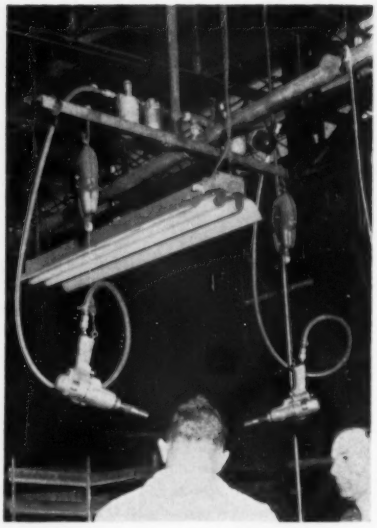
Using the same base diameter, it is reported that 5000 rpm could constitute a "high-speed" part in certain products, but is low compared to others. For example, 20,000 rpm is the range of speed of many supercharger impellers.

A CONSUMER PRODUCT

Lightweight and attractive, a power mower must also be rugged enough to withstand hard use by consumers that are often reluctant to practice even the rudiments of preventive maintenance.

AIR SYSTEM

Compressed air for the Impactools is routed through separators and lubricators prior to use. In approved fashion, the feeder line is taken from the top of the distribution main. The tools are suspended from balancers.



Torsion Bar Impactools Assure Positive Torque Control, Help Lawn-Boy . . .

TO BUILD A BETTER MOWER

IMPROVED quality control of fastener torque at critical points of stress has been achieved in the assembly of Lawn-Boy power mowers through use of automatic torque-limiting Impactools. In addition to meeting the primary demand for quality control, Ingersoll-Rand torsion-bar air tools in use at the firm's Lamar, Mo., plant have increased efficiency on the assembly line.

Power lawn mowers are a highly competitive product, and a successful manufacturer must offer a well-groomed machine at a moderate price. As a consumer product, it has to perform well under varied operating conditions, for a variety of users; and must require little or no maintenance, despite neglect and rough use. The success of Lawn-Boy in meeting such exacting specifications is evidenced by mounting production—the firm's one millionth mower was produced early this year. The Lamar works has a production capacity of about 200,000 machines a year. Lawn-Boy is a division of Outboard Marine Corporation, familiar to sportsmen as the manufacturer of Johnson and Evinrude outboard motors.

Two points where fasteners are subjected to heavy stresses on a power mower are the wheels and the cutting blade. The Lawn-Boy design provides for a staggered 4-wheel arrangement with one of the four "activated." The latter, called a pilot wheel, follows the contours of the ground yet keeps the mower on an even keel to attain an even surface. In addition to normal rolling shocks, vertical loads are imposed on the wheels as the mower moves over rough ground, stones, twigs, etc.

Each wheel on the unit is assembled to its die-cast aluminum housing with a ⅜-16 mild steel shoulder bolt with two plain washers, a split lock-washer and a lock-nut of special design. Engineers stipulated that the bolts be run to a torque of from 23 to 25 foot-pounds.

The cutting blade is another part that must be attached firmly. A "slip-clutch" arrangement compensates for heavy shocks caused by occasionally hitting hard objects, but otherwise the blade should not slip because it would adversely affect the cutting action. The blade assembly includes the blade, a blade stiffener, four washers of steel, one of rubber, and one of fiber as well as a safety washer, all held to the drive shaft by a ⅝-inch nut. Design engineers set the torque requirements for this sub-

LAWN-BOY'S LAMAR WORKS

More than 1,000,000 mowers have been produced in the factory shown in this illustration. Lawn-Boy is a division of the Outboard Marine Corporation, known to sportsmen as the manufacturer of Johnson and Evinrude outboard motors. Air-powered torque-control Impactools boost quality and production here.

assembly at between 40 and 50 foot-pounds.

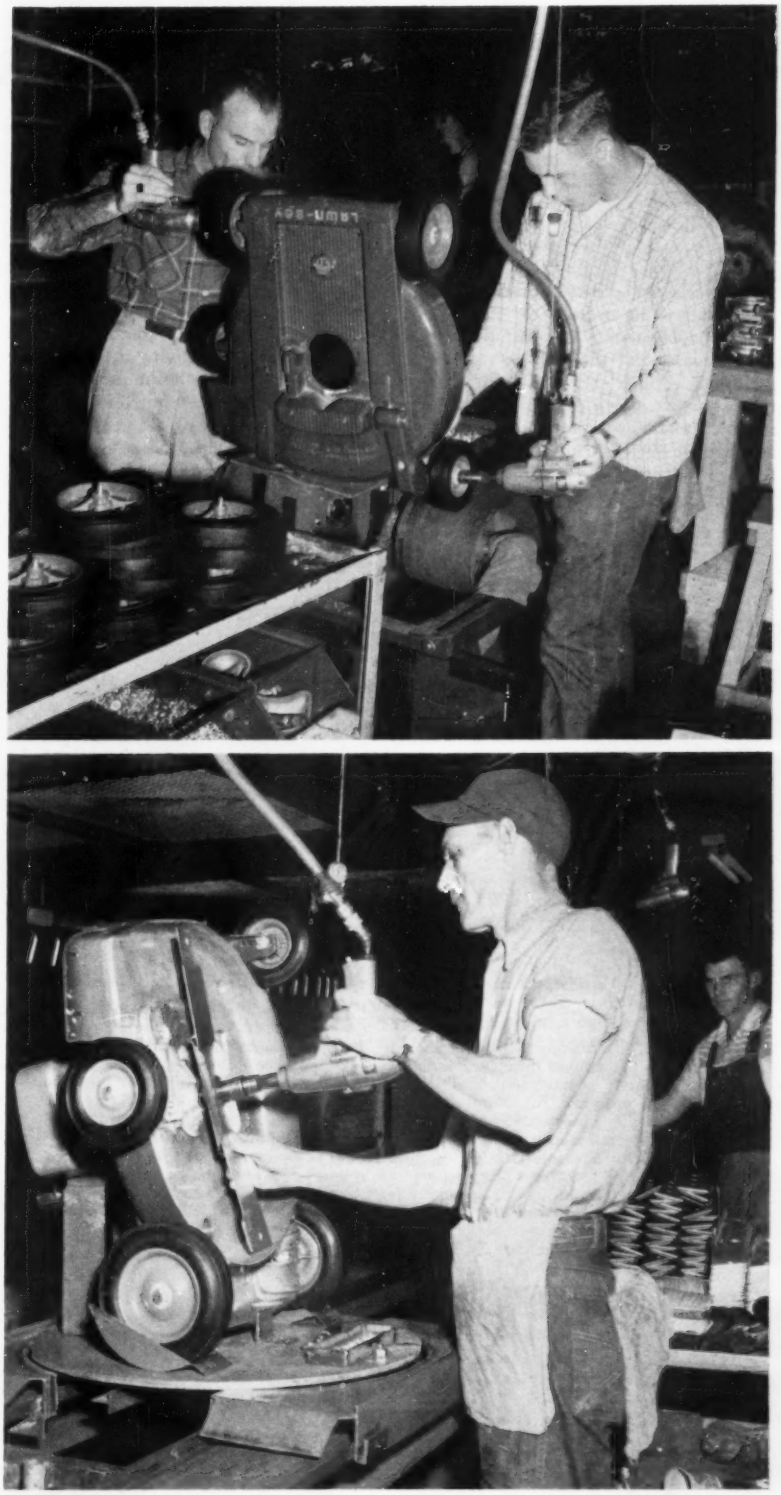
Both for wheel and blade assembly, Lawn-Boy originally used electric impact wrenches. Operators attempted to judge torque by estimating the number of seconds the tool impacted. Although still common practice in many assembly operations, Lawn-Boy engineers recognized that method as an imperfect means of torque control and used a careful—and expensive—inspection system designed to guard against loose or faulty assemblies.

In July 1956, the company adopted Ingersoll-Rand Size 5040T Torsion Bar Torque Control Impactools for the wheel assembly job. Men work in pairs, one on each side, so that all wheels can be attached without turning the mower. Each is equipped with a torque-control tool suspended from a tool balancer. The tools automatically shut off when the torque exceeds the twist preset in an integral torsion bar. Success of this operation led to the installation of additional tools in October 1956, for the blade assembly job.

Torque values produced by the tools are set in the tool crib and checked with a hand torque-wrench. For the wheel assembly, tools are calibrated at 25 foot-pounds and for blade assembly, at 45 foot-pounds. The operator on the assembly line has nothing to do with torque settings—control is entirely in the hands of the tool engineer and his maintenance men.

After a year of experience with the torque limiting tools, Lawn-Boy engineers report that their production quality objectives have been achieved. Inspectors have noted a substantial improvement in quality control, reporting that all wheel-and-blade assemblies inspected are within specified torque limits. The tools, it is reported, run to virtually the same value time after time. Further, although the torque-control tools have run hundreds of thousands of nuts and bolts on the Lawn-Boy assembly line, it has never been necessary to reset a tool because of faulty tightening. (Tools have been reset, but only after disassembly for maintenance.)

Although quality control was the primary objective of the retooling program, increased production efficiency is also reported. The two main benefits are closely interrelated. With the old method, operators usually tried to assure adequate torque by letting the tools impact longer than necessary. Less conscientious men achieved greater production rates at the expense of quality. Over-torque, under-torque and loss of time resulted. With the new tools, no such guessing or hurrying is possible; the tool shuts itself off at the proper moment. Operators, in turn, now move decisively and with confidence at a faster production rate.



CRITICAL FASTENING JOBS

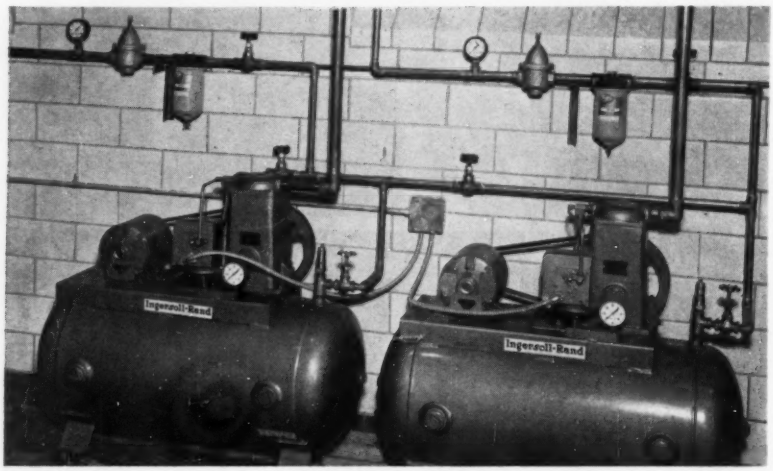
In these illustrations are shown the tasks to which Ingersoll-Rand Torsion Bar Torque Control Impactools were assigned. The size 5340T tools solved a quality control problem on each. In wheel assembly work (top), the tools run fasteners to a specified torque of 23 to 25 foot-pounds. The other applications, assembling the cutter blade to the power shaft, calls for a torque of 40 to 50 foot-pounds. As an added benefit, the tools also increase production.

A Growing Use For Oil-Free Air—

MILK DISPLACEMENT

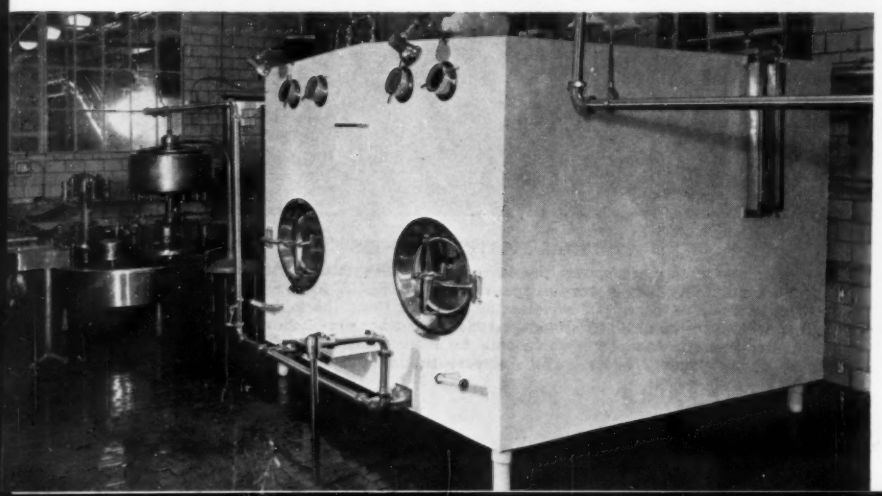
SINCE the war, a great many dairies have made installations of nonlubricated compressors. Oil-free air from these machines has been applied to a variety of tasks, among the most important of which is displacement or pumping. Various studies of this technique have brought to light a number of benefits to its users.

Air displacement, for example, eliminates the use of sanitary pumps. Because all piping and other equipment must be torn down at the end of each day's run for complete cleaning and sterilizing, getting rid of the more or less complicated pumps offers big savings in tear-down and cleaning time. Then too, a less expensive and less complicated sanitary piping system is required, again making disassembly and cleaning easier. Furthermore, it is reported that moving milk with compressed air results in less waste because lines are completely purged, something that a pump, no matter how efficient, can't accomplish. Air displacement also transfers milk with less disruption than do other means of moving it, thus causing less frothing or foaming. This is important because too much foam might not only interfere with proper operation of bottle- or carton-filling equipment, but also the uniform make up of homogenized milk is better preserved.



FORSGATE FARMS

Oil-free air at Forsgate Farms, Jamesburg, N. J., displaces milk at a flow rate of 32 gallons per minute through 2-inch stainless pipe from a 2-compartment, 2500-gallon capacity rectangular holding tank, that was specially designed to withstand 7-psi pressure. Air of but 4 to 5 psi is all that is required to push the milk to a bottle filler however. Two Fisher Governor Company regulator valves (Model No. 734R-1) limit maximum tank pressure to 5 psi. The tank is shown in the lower picture. Two Ingersoll-Rand 5x1¼-inch Model N compressors each driven by a ½-hp General Electric motor, supply the system. Prior to use, any condensed moisture is separated in Commercial Filters Corp., Fulflo in-line filters. The compressor plant is shown at the top. Forsgate Farms Dairy has a daily capacity of about 35,000 quarts per day of pasteurized-homogenized milk and processes other dairy products as well.



Compressors of sufficient capacity must be installed if the displacement equipment is to keep up with the rest of the dairy machines. Experience has shown methods for determining air pressure and volume requirements. Pressure determination is accomplished by summing the friction head (the resistance to flow of pipes, elbows and valves) and static head (the distance the milk must be lifted). Tables are available giving the equivalents, in feet of head, of various runs of pipe, elbows and valves. Then, converting to pounds per square inch is but a matter of dividing by 2.31, the dividend expressing the minimum air pressure needed.

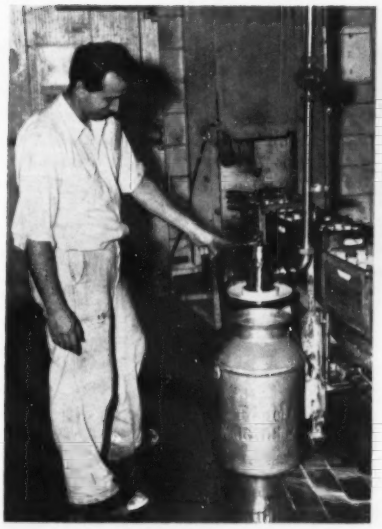
Volume determinations are a simple problem of converting the number of gallons, or quarts, per minute required, to cubic feet. This has to be expressed, however, in cubic feet of free air since that is the way most compressors are rated.

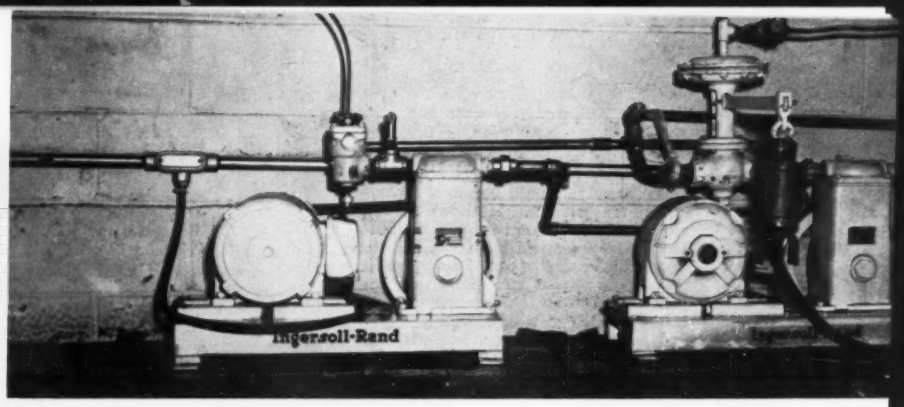
Although in general, pressures required in dairies are not too great (usually in the range from 5 to 30 or 35 psi), improper selection of equipment may lead to inefficient operations along with waste and poor sanitation. According to engineers it is of importance that all equipment be designed for the pressure it must withstand. The accompanying pictures illustrate a number of different installations throughout the country, and their captions give pertinent data about their operation.

Many establishments are using oil-free air not only for displacement, but for agitation (to keep cream globules widely distributed in raw whole milk) and for control of instruments and flow valves on short-time pasturizers. Use of oil-free air is economical both for large and small dairies.

FAIRLAWN DAIRIES

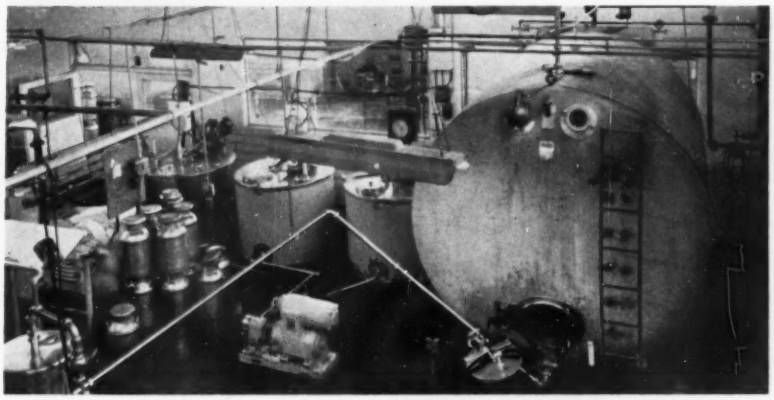
Two Ingersoll-Rand 3-hp HNL compressors supply air to Fairlawn Dairies at Fairlawn, N. J. A pressure of 8 psi is utilized for displacement in five tanks: one 2500-, one 1500- and one 7000-gallon holding tank; a 500-gallon skim milk reservoir; and one of 550 gallons for buttermilk. The holding tanks are pictured at the right. Milk flows from the tanks into a 2-inch diameter sanitary header, and thence to 1½-inch diameter feeder lines relaying it to the bottle and carton fillers shown in the other photo at the far right. Fairlawn Dairy displaces some 2200 ten-gallon cans of milk each operating day. An average day's run consists of about 2000 cases of 1-quart bottles at 12 quarts per case; 3000 cases of 1-quart cartons, 20 quarts per case; 300 cases of ½-pint cartons, 60 containers per case; and 200 cases of 1-pint cartons of which there are 30 pints in each case. In addition, on alternating days, either 4000 quarts of skim milk or 4000 quarts of buttermilk are bottled. The dairy also makes production runs of orange drink, chocolate milk, and light and heavy creams as required.

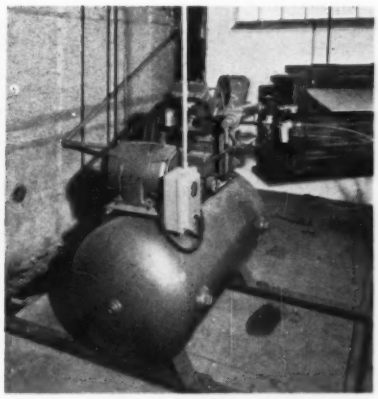




JOHANNA FARMS

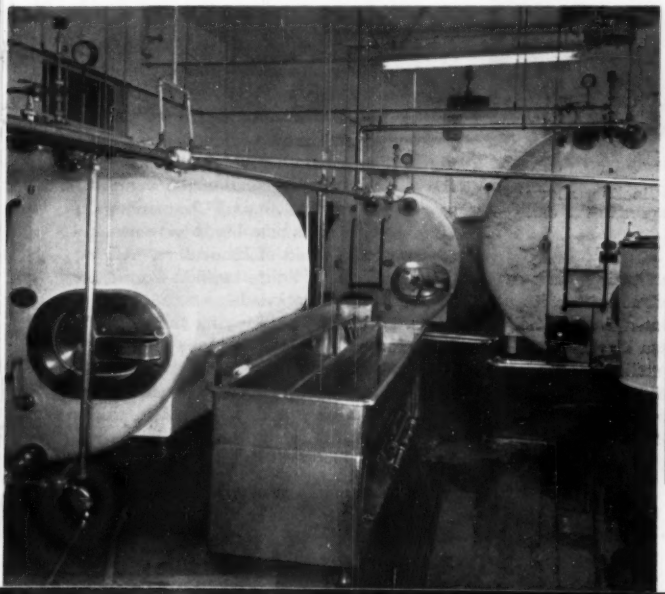
In Flemington, N. J., Johanna Farms Dairy is using two Ingersoll Rand NX1 compressors. Oil-free air is utilized for moving milk from two holding tanks to a bottle filler of 120- to 140-quart-per-minute capacity as well as to two carton fillers, each with an 80-quart-per-minute capacity. The two compressors are illustrated above. At the left is shown a bulk can filler also served by the manifold system running from the tanks, which have an aggregate capacity of 2500 gallons. Many dispensing machines utilize milk in bulk cans, thus Johanna Farms put in this special filling station. Air at 5-psi pressure is used for displacement. Piping is arranged so that milk can be routed to a number of other vats and processes in the dairy, as well as to the fillers.

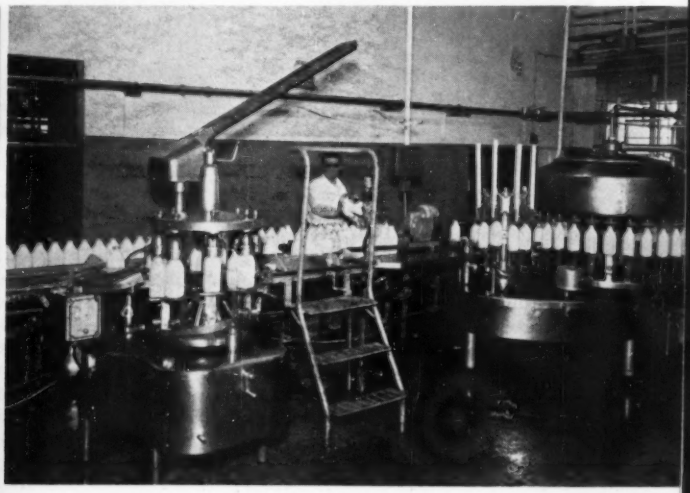




O'FALLON DAIRY

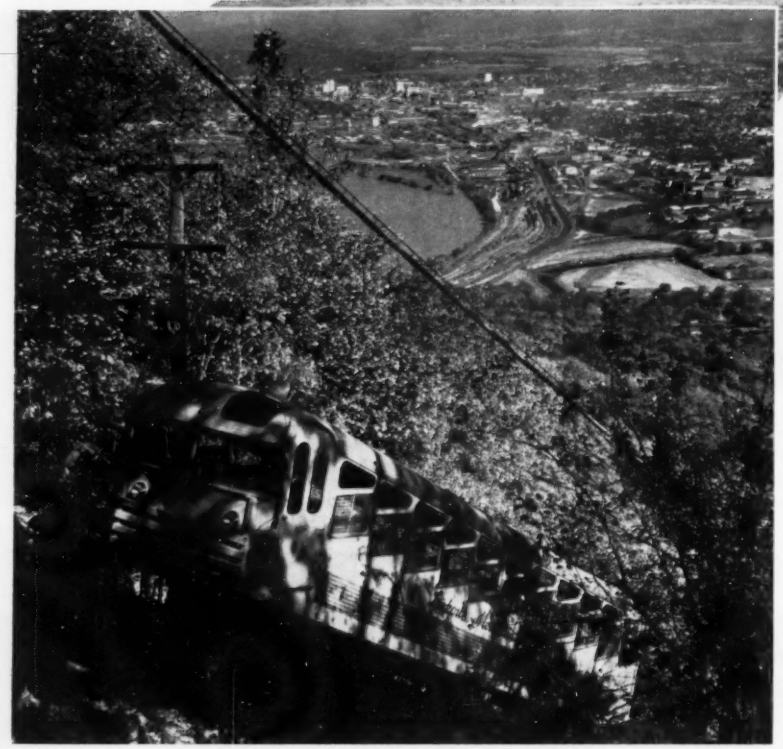
The O'Fallon Quality Dairy, O'Fallon, Ill., uses oil-free air both for displacement and agitation. An Ingersoll-Rand Model 235HNLC2 compressor supplies air to a 3000-gallon capacity holding tank designed for the pressures involved. On the agitation cycle, air pressure is reduced to 5 psi; on displacement, it is used at 15 psi. Three filling machines are in use: one handling thirty-four ½-gallon cartons per minute; another, sixty ½-gallon bottles; and a third, forty-six 1-quart bottles. In this pair of pictures, the compressor is shown at the right and the holding tank at the left. Milk is held for about an hour in the tank, during which time it is thoroughly mixed by air agitation. Then the agitation line is bypassed (to prevent the large quantity of air required for displacement from passing through the milk itself) and 15-psi pressure imposed on the tank to move milk to the filling machines.





MOUNTAINTOP TERMINAL

The recently rebuilt terminal at the top of the mountain is shown in this view. Also included in this building are the engine and hoist room and the operator's control room. The construction of the cars is also shown and the seat arrangement that enables the passengers to sit at a comfortable angle.



OVERLOOKING CHATTANOOGA

This photograph, taken on one of the steepest sections of the incline, shows the commanding view of the city of Chattanooga afforded passengers in the car.

CHATTANOOGA'S CABLE CHOO CHOO

The incline railroad at Chattanooga is the world's steepest

PAUL C. ZIEMKE

IN THE 62 years that The Lookout Mountain Incline Railway at Chattanooga, Tenn., has been in service, visitors have come from all over the world to experience the thrill and excitement of moving up the mountain at a breathtaking angle that, up one stretch, reaches 72.7 percent—a slope of approximately 65.5 degrees. The road is 0.9 miles long and a rider gazing back over the steeply receding track from its upper terminal looks down from a height of 2450 feet above sea level.

The Chattanooga incline railroad was planned and built in 1895 when Congress created the Chattanooga and Chickmauga National Military Parks. At that time the upper level, now composing an adjunct to the military park, was privately owned, and the railway was built to exploit the wonderful view available from the escarpment just west of its upper terminus. From this vantage point passengers not only obtained an aerial view of the battlefield below, but also of the scenic Moccasin Bend of the Tennessee River and the City of Chattanooga. On clear days it is possible to view seven states with the aid of binoculars. After dark, millions of lights twinkle from the surrounding countryside.

Today the area occupying the bulk of the plateau's western end is built up with modern churches, schools, motels and a resort hotel. The real estate is relatively high-priced and, being situated so far above the city proper, the residents of Lookout Mountain have their

own water supply system. Its bright aluminum-painted standpipe is visible throughout the city of Chattanooga. The citizens of the "above-the-clouds" settlement make up a large portion of the passenger traffic on the incline. Its lower terminus is served by express buses to the city and a separate auxiliary service functions on the plateau. State Highway 58, a well engineered motor-vehicle-way, makes the climb in a long sloping approach.

Not only is the view an attraction for the first-time tourist passenger, but he is also impressed by the fact that as the car slowly makes its way to the summit, the temperature is distinctly lowered. As is the case in Great Smoky Mountain National Park, where lower temperatures make possible the growth of a variety of northern species of plant, the upper levels of Lookout Mountain also are conducive to the growth of hardwoods, etc., while the lower slopes abound with laurel and rhododendron.

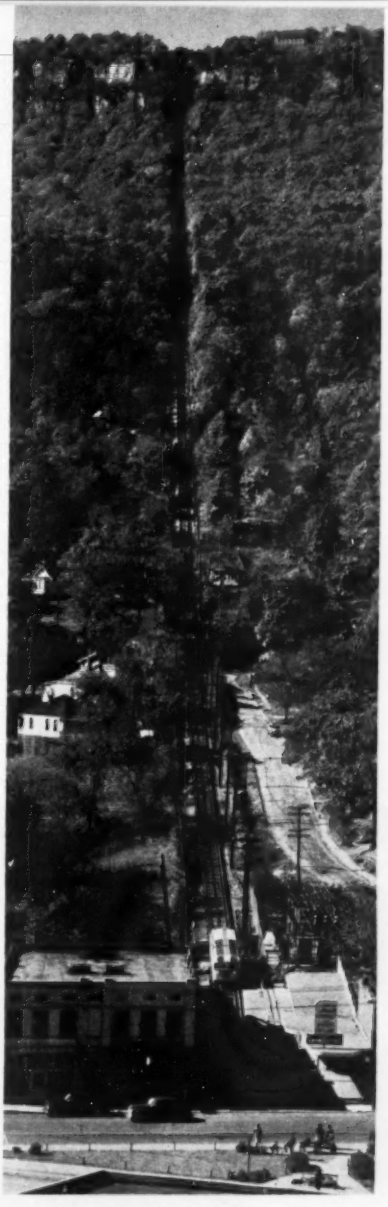
About half way up the incline an intermediate station is located. Coinciding with a busy mid-mountain highway, the lower portions of the battlefield can be reached from this point, as well as Lookout Mountain Caves, inside of which the noted 145-foot-high Ruby Falls are located. From Halfway Station to the top, the steepest grades are encountered: the average grade over the incline is about 35 percent, but near the summit the 72.7-percent grade is reached.

Besides being the "World's Steepest," the incline has also earned the title of the "World's Safest": no accident has befallen any of the passengers that have ridden on the 1¼ million trips made by the cable cars.

The incline spans a vertical distance of 1500 feet. The trip takes about 8 minutes and the cars run 18 hours a day (6 a.m. to midnight), 7 days a week throughout the year. They operate on a fixed schedule that results in 3 to 4 trips per hour depending on the time of day. From the Mountain Top Terminal, it is but a short walk (2 blocks) to Point Park, and similarly short distances to the War Museum, Umbrella Rock and the start of many fine foot trails.

Two cars operate on the road in a counterbalance arrangement to lessen the horsepower requirements of the driving motors. Over most of the route, including the sections at the terminals, there are but three rails. At the midpoint however, where the cars pass, the road widens. Permanently set "switches" steer the cars aside and then back onto the 3-rail road. (Each car uses but two of the three rails, the center one being common to both.)

Two cables are attached to each car. The ropes are 1¼ inches in diameter and a single one is sufficient to handle the greatest loads encountered. The extra cable is "insurance." The cables are exposed to all the rigors of the weather and are lubricated twice a year: in the spring with Texaco 1-A summer grade, and in the fall, with Texaco AD4, the latter being more resistant to the incessant rains of the mountain area. The cables ride on idler rolls over the entire length of the road and the latter are greased once a month in dry weather and as often as once a week in the rainy season. Brass sleeve bearings are used in the idlers. To replace the cables on the system costs about $10,000. They have been furnished for many years by John A. Roebling's Sons, now a part of Colorado Fuel & Iron.



THE INCLINE

This aerial view shows the world's steepest incline railway. It is also called "The Safest" and is often referred to as "The Miracle Mile". The midpoint can be faintly discerned as the wider section of track. It takes 8 minutes to travel the 0.9-mile route.

Like many other incline railways, the Lookout Mountain road once was steam powered. The old plant gave way in 1911 to an electric-motor-powered hoist designed and built by the Otis Elevator Company. Two 130-hp motors were used, each driving a large diameter brake-wheel, 8 feet across. The drives are of the traction type common to most elevator installations. Upper and lower limit-switches are in use as well as a fly-ball-operated governor that stops the motors if the cars should exceed a speed of 8 miles per hour. The hoists have band-type brakes along with a no-voltage release mechanism that automatically sets the brakes in event of a power failure.

The cars are of steel construction, and are built to provide a near level seat during the steep climb. They also have astradome roofs to aid the sightseer. Each is equipped with an Otis double grip safety lock capable of holding 50,000 pounds on the steepest grade. The latter are also set automatically by governor-controlled actuators, or can be set at will from within the car by the conductor. An additional safety feature is provided to engage the traction driving sheave on the car. It too, is applied by a governor-controlled actuator and functions if the hoist should exceed a safe speed.

The incline is equipped with electric controllers that are arranged to automatically slow and bring the cars to a stop at the terminals—the action is entirely independent of the hoisting engineer who controls all other movements from the hoist station at Mountain Top. A positive-action indicator is located at the head of the incline to enable the operator to know the position of his cars at all times. The indicator is of greatest importance at night and during heavy fogs and is illuminated at those times.

The Lookout Mountain installation has several counterparts in this country—one that operates in Duluth, Minn., differs from the Chattanooga incline only slightly. For example, it has only one large cable per car and has a telephone circuit to enable the conductor to talk to the hoisting engineer. The Chattanooga line instead uses a type of telegraph to relay signals.

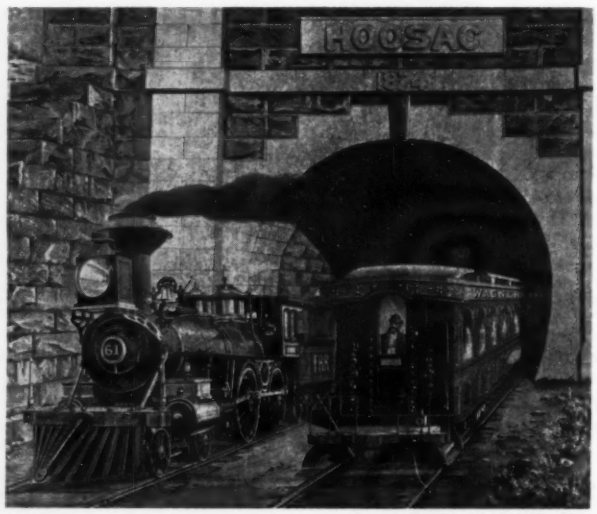
A $250,000 modernization program was embarked on in 1949 for the Lookout Mountain road. Old wooden cars were replaced with the present modern ones and both terminals were reconstructed of fireproof materials. Gasoline-engine-powered generators on the cars provide electricity for lighting and liquefied-petroleum-gas heaters are used to warm the cars in winter. Modern plastic upholstery, well-padded, has been used instead of harder seats as in the old cars.

"Daylight Through the Mountain"

TUNNELING through the Hoosac Mountains of Massachusetts represented not only an engineering feat for which construction men can be proud, but a milestone in tunneling, for in 1869 efficient pneumatic drills were introduced in this type of work in America, the European counterparts being the bores through Mont Cenis and St. Gotthard Pass. Equally important is the fact that the final 4 years of the project gave birth to professional engineering. The last two contractors were not only technically skilled, but were well aware of the benefits that could be derived from good public and employee relations and the apt use of men and material. These two, Canadian brothers, were Walter and Francis Shanly, and *Daylight Through the Mountain* is their story as told by them in letters and memoirs.

DAYLIGHT THROUGH THE MOUNTAIN, LETTERS AND LABOURS OF CIVIL ENGINEERS WALTER AND FRANCIS SHANLY, Frank Norman Walker, Editor; Gladys Chantler Walker, Researcher; The Engineering Institute of Canada, 1957; $7.50.

The letters begin in 1843 and are, in the main, from Walter to Francis, the former being a gifted correspondent with broad interests, personal integrity, enterprise, spirit, executive ability and an enormous Irish vigor. The early writings are primarily concerned with family matters; however, as the Shanlys became involved in railroading — particularly on what is referred to as the Ogdensburg line — Walter began to appear as a man of action. When the two were given a contract by the State of Massachusetts to finish work on the Hoosac Tunnel, their letters, telegrams and press releases (written by Walter) prove that they had attained the level of personal and business accumen and integrity that we today require of professional engineers.



BETTMANN ARCHIVE PRINT

The story of the Hoosac Tunnel began in about 1819 when a group of enterprising individuals proposed a canal from Boston to the Hudson River to provide a more direct route from eastern Massachusetts to western New York and the Great Lakes. The Hoosac Mountains stood in the proposed path. In 1825, surveys were made, and the task, seemingly impossible, was dropped from the public mind.

Meanwhile, railroads were growing rapidly both in the United States and Canada. Their tracks were unreasonably long, following the lazy contours of the earth. As competition grew between the various lines, and at about the same time as the Shanlys were at work on the Ogdensburg Railroad, the public once again dreamed of a tunnel through the mountains. Plans were made to build the railway, and a charter was issued to the Troy & Greenfield Railroad Company to construct a line from Greenfield to Williamstown, Mass. Surveys were again made and work began in 1851 on what was to be a 4¾-mile bore for double tracks. Driving began at the east and west sides as well as on a 1028-foot central heading shaft. Because the latter entered from a swampy section, flooding was frequent and pumps were needed.

Knowing that successful completion of the project would be beneficial to the State, its support was given. It advanced $2 million as a loan to the contracting company, the money to be repaid in installments. The first contract did not produce results. Another was let for $3,880,000, and later, this amount was increased to about $4 million. Work dragged and funds gave out. The State foreclosed its mortgage, deciding to do the work itself. Expenditures were beyond reason as compared to the amount of work done. After 6 years of repeated attempts, rumors that the money was going into the pockets of certain State officials spread rapidly, and the Hoosac Tunnel project became a first rate scandal. What the total cost really was, has never been determined.

In 1868, the State voted an additional $5 million for a general tender to carry the work to completion. On June 18, 1868, a letter was sent to Francis Shanly from Benjamin Latrobe, consulting engineer to the State, and said in part, "I hope you will visit the tunnel and give. . .tender for it. . . .It is the sort of work that might suit you well." From this, the brothers began what was to become their greatest single project.

After a long series of negotiations, Governor Bullock announced (January 1, 1869) that "The contract for the construction of the Hoosac Tunnel. . . with Walter Shanly of Montreal and Francis Shanly of Toronto, Canada, for the sum of $4,598,268" had been awarded. Although 9338 feet had been previously bored, the cross section was ragged, varying from 170 to 260 square feet. Consequently, so that enough space would be available for the double tracks, a section 26 feet high, with a cross section of 575 square feet, had to be cleared. Thus work began anew at both portals.

"Drilling by compressed air was commenced last Monday at the east end" appeared in a press release dated April 1869. Air was supplied by compressors that were designed by Thomas Deane, chief engineer of the tunnel, and made by Burleigh Rock Drill Company. They operated by water power at the portals and steam power at the shaft. Each machine had four horizontal, single-acting air cylinders with poppet valves and water injection.

The first successful drills were built by Charles Burleigh, John W. Brooks and Stephen F. Gates, and were based on patents issued to J. W. Fowle. The drilling bar was rigidly attached to a nonrotating piston, and each struck about 200 blows per minute. However, because they broke easily, Burleigh redesigned them, providing them with a rotating piston and bar. At about this time, Burleigh bought the rights to Fowle's patents, the resulting drills being the basis for Simon Ingersoll's machine of 1871.

Each drill weighed about 540 pounds and, at a pressure of 60 psi, made about 200 strokes per minute. The hole drilled was 1¾ inches in diameter. Exhaust from the equipment in the tunnel provided fresh air for the workers at each face.

One of the first things that Francis did to increase the driving rate was to

mount the drills on wheels so that they could be easily withdrawn before blasting. Two carriages, each with six drills, operated at each front. Gradually more Burleigh units were put in, and new compressors had to be added. One of these additions was reported in the *North Adams Transcript* of July 5, 1869: "At the west shaft of the tunnel, four new air compressors are being put in, each of which runs ten drills making a two inch hole and capable of sinking a foot a minute." The *Greenfield Gazette* announced on July 26, 1869, that "new drills (have been) made to operate on the roof. . . ." and went on to say, "One thing is certain, the contractors believe the work can be done. . .and they mean to do it."

Beginning in December 1866, blasting was done with nitroglycerin instead of black powder, the first use of high explosives in America. The mixture was manufactured by G. M. Mowbray. An editorial in the *Journal of the Franklin Institute* (March 1871) had this to say about blasting: "Though it costs ten times that of blasting power (*sic*), it is nevertheless found advantageous to employ it in certain portions of the work. . . .the number of holes simultaneously charged varies from ten to fifteen, their depth usually 60 to 72 inches where the hole is horizontal; where the hole is vertical, the charge is put down ten feet and upwards. . ."

Driving through mica schist, granitic gneiss and conglomerate, the maximum speed in a single heading was 184 feet in 1 month of 26 working days. During the last 6 months, the average advance was 4.2 feet per day.

As examples of the Shanlys' wide interests, it is interesting to note that after repeated failure of charges to explode, they established a detonator factory in North Adams. It was operated by two local brothers of the name Browne. After creating the new industry, they built a suburb on the mountain at the site of the central heading. It was complete with a meeting house and a school. At another time, after a long and severe storm had halted operations on a railroad used by workers to get to the tunnel, they built accomodations nearby at a cost that was not reckoned in their contract.

A 2-inch speaking hole was put through from the east and west fronts on November 26, 1874, and the final blast took place the following day. As a testimony to the Shanlys' engineering prowess, one can look at the center line of the Hoosac. It was established by them, Francis working at the west end, and Walter, at the east. Holes were drilled at regular intervals into the rock which formed the tunnel ceiling. These were plugged with wood from which was suspended a series of plumb bobs. After the 4 years required to complete the job, when the two working forces met, the error of closure was but $\frac{3}{16}$ inch. Reportedly, European tunnels of equal length and driven under similar circumstances were often out by as much as 18 inches.

"Send for Frank Shanly" was the call that came from Canada after they had been working on the Hoosac for 3 years. Railroad building there was increasing rapidly and his council was needed. At first, he commuted between North Adams and various points in Ontario, putting reliable men in charge wherever he went. However, the organization in Massachusetts was so well planned, that he finally left his brother to handle the job alone.

After the project was completed, the Shanlys were called as consultants on numerous engineering jobs; Francis on railway construction, and Walter on waterworks. Francis conceived the master sewer plan for the City of Toronto and straightened the Don River there. He was appointed Chief Engineer of the government-owned Intercolonial Railway. On September 13, 1882, he died, "not only an engineering genius, but a *prince among men*, the soul of honour to all who knew him."

Walter continued his work and helped Casimir Gzowski to found the Canadian Society of Civil Engineers, the two of them becoming the organization's president and vice-president. He died at the age of 83 on December 17, 1899.

Daylight Through the Mountain was researched by Gladys Chantler Walker and edited by her husband, Frank Norman Walker, a contributor to the new *Encyclopedia Canadiana*. His wife has been active for many years in Victoria University and served for 8 years as a member of its Senate. She is a speaker of renown and has published many biographical and historical articles.

The publisher, The Engineering Institute of Canada, has declared a policy of publishing suitable biographies of early Canadian engineers. This is one of that series. Through its conscientious efforts, this fascinating dual biography has been made available to engineers and the public, making them aware "of the manner in which their professional ancestors met the formidable physical and human problems of long ago."

—*S. M. PARKHILL*

This and That

Film Crusts Halt Erosion

As much as 4 tons of anthracite coal fines of the type produced by froth flotation methods may be blown from an open hopper car during a 400-mile journey, it is reported. This represents more than $20 at current coal prices, including the freight price paid at point of lading. Similar losses occur with different minerals and ores not only during shipment, but when stockpiled and exposed to wind and rain erosion. Reagent S-3152 is a new product of the Mining Chemicals Department, American Cyanamid Company, that forms protective crusts over mineral fines either in stockpiles, open rail cars or trucks. The chemical is a water emulsion, milk-white in appearance, weighs 8.8 pounds per gallon and contains 46- to 48-percent solids by weight. It is noncorrosive and can be infinitely diluted with water to make any strength spray required. (The usual spray make-up of the solution is about 3- to 15-percent solids.) The reagent is composed primarily of resins that set to form a tough crust in combination with the surface fines. The setting process takes about 6 hours. The material sells for $0.28 per pound, in 450 pound drums. Tests have indicated that from 275 to 350 square feet of surface can be protected with one gallon of S-3152 diluted as required.

★ ★ ★

Underground Heat Transfer

Since World War II much attention has been given to the use of natural or man-made caves by military, industrial and civil defense groups both for storage and personnel shelter. One of the problems encountered is that of maintaining the space at a selected design temperature that may differ from that of the surrounding rock. Studies at the National Bureau of Standards, carried out for the Army, have provided a quantitative basis for predicting mathematically how much heating or air conditioning a particular chamber will require to maintain a constant temperature. The analysis has been confirmed by recently completed field tests in a chamber 100x35x10 feet, and several hundred feet underground. In the test setup, a constant heat input of 8.4 Btu per hour for each square foot of projected area of rock surface was applied to the chamber for 139 hours. This raised the temperature from 53.8° to 75°F. At the 75° mark, thermostats regulated the heat input to maintain that warmth for 110 days. Comparison with theoretical data then indicated that the required heat input was slightly higher than that of the forecast. Correction factors were evolved based on the size of the chamber, and thus it is

now possible to solve similar heat transfer problems in a variety of different sized and shaped cavities.

★ ★ ★

Largest Vacuum Furnace

Allegheny Ludlum Steel Corporation has placed in operation what is believed to be the world's largest furnace for melting high-purity super-alloys under vacuum. The unit, using a consumable electrode remelting process pioneered by that company, is capable of producing 26-inch-diameter ingots weighing as much as 12,000 pounds. Reportedly, these are the heaviest ever produced by a vacuum melting process. By making these ingots commercially available, super-alloys, such as A-286, can be used in such applications as gas-turbine-wheel components, jet-transport landing-gear parts and large steam-turbine-generator retainer rings, that were previously impossible.

★ ★ ★

Power From Glaciers

Mer de Glace, famous glacier on the slopes of Mont Blanc, will soon become more than just a scenic beauty. Beneath the moving ice mass flows a river that will be tapped at an altitude of 4700 feet above sea level. The liquid will be shunted through a mile-long tunnel, connecting with high-pressure pipes, and will be dropped 1200 feet to an underground power station in the valley of Chamonix. The hydroelectric project is being sponsored by the French government.

On the other side of Mont Blanc, the equally well-known Argentiere glacier will be similarly harnessed. Water will be led from the fast-flowing river through a series of tunnels, 27 miles long, down 6500 feet into the Emosson basin on the French-Swiss border. At this point, a dam will be constructed and the water will be directed into two power stations. The energy generated by the facility will be equitably distributed between the two countries. Electric power production eventually is expected to reach 600 million kw per year.

★ ★ ★

Inverse Magnetic Properties

A discovery by Ford Motor Company scientists will lead to a revision of many basic science books and may prove to be a missing link in the study of magnetism. It has always been believed that magnetic metals become more magnetic when their temperatures are lowered. Now it has been learned that the reverse can be true. By adding aluminum to iron, Ford scientists have created an alloy whose magnetic properties decrease as heat is extracted. Since the addition of aluminum to iron also creates a noncorrosive alloy, the researchers suspect their discovery may be an important clue pointing to a close relationship between rusting and magnetism. Called antiferromagnetism, the phenomenon has previously been found only in certain nonmetallic chemical compounds.

Old Plans For The Seaway

As the opening of the St. Lawrence Seaway comes ever nearer to bringing financial prosperity to many new sections of the United States and Canada, the areas are approaching the situation in a variety of ways. The State of Pennsylvania, for example, in an attempt to expedite its own growth, has dug out 20-year-old plans for a water link between Lake Erie and the Ohio River. Two routes were originally proposed by the U. S. Army Corps of Engineers and are again being studied. One would follow the Beaver and Mahoning rivers to Youngstown, from where the waterway would move, via locks, to Lake Erie. The second proposed route runs from the Allegheny River to French Creek and, by canal, would enter the lake west of Erie, Pa.

★ ★ ★

Subways For Sweden

Stockholm's first complete trans-urban subterranean transportation system was put into operation late last year when a link between the previously existing southern and western subways was inaugurated. The system now comprises 39 stations and provides 19 miles of facilities for through traffic between the northwestern and southwestern suburbs. The entire project represents about 16 million working hours and an expenditure of nearly $120 million, a fifth of it being spent for the final section. The scheme was planned shortly after the turn of the century, and the first portion of the system was opened in 1933.

MAGNOLIA/CUL-DE-SAC

"Railroad Relics of a Bygone Day" was the cover caption of our July 1957 issue. The picture to which it referred recalled "home" to one of our readers who sent us the photograph reproduced above. The original picture was taken from a postal card, and is dated 1910, just a decade after our cover picture was taken. It illustrates the town of Culdesac, Idaho. According to the letter received, the trestle we pictured on the cover was one of the largest wooden trestles built by the Northern Pacific Railroad in its attempt to gain, over a distance of 7 miles, about 1500 feet of elevation over the mountains. Culdesac, nestled at the foot of this grade at the end of the line, was orginally called Magnolia, but was renamed when a railroad executive expressed the opinion that Magnolia was truly a cul-de-sac, for he doubted that anyone could build a road up and over the foreboding mountains ahead. The trestle we illustrated was about half way up the elevation. Since the picture of the town was taken, scarcely a building is left standing as a result of a rash of severe fires. All that remains of the town are a few scattered residences and the school, with remnant buildings of brick on Main Street. Once a lively town, it was a trading center for miners and farmers.

EDITORIAL

Standards

LORD KELVIN once said, ". . .when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be."

The 4-year old at our house has her own units of time measure. The basic one is "a little while." Longer than that is "a couple of little whiles." Her mother and father haven't yet figured out a conversion factor to translate into minutes, seconds or hours. It can be confusing, to say the least. All of this, of course, leads up to the importance of standards.

THE development of practical systems of measurement, and standards therefor, has occupied men's minds from the very beginnings of history. Each of the Egyptian dynasties, indeed each pharoah ruling, set up standards of weights and measures. It has been demonstrated that standards of measure are more important than the scales themselves. In other words, it makes no difference if the yard stick we use is short or long, just so all of us use the same one.

There are many other standards. Quite a few of them relate to screw threads, and for those of us used to specifying a nut by several numbers and being sure that it will fit the stud we have in mind, the prestandard days when every manufacturer had his own specifications, seem like chaos itself.

MOST standards in this country arise from the American Standards Association. Founded in 1918, it is a nonprofit federation of 29 technical societies, 85 trade associations and 2271 business companies. The group defines an American Standard as "a common national agreement on the one best way to do something, make something, measure or test or define something, or make it safer." At a recent count, 1687 American Standards were in daily use in this country. Of them, 152 are in the field of mechanical engineering; 160 are American Safety Standards; 263 deal with civil engineering and construction; 2 detail codes covering the installation of electrical equipment, and in relation to the latter, 440 or more cities have enacted ordinances based on one or both. There are many other standards and codes covering a wide range of things from plumbing to motor frame sizes.

According to the ASA, some 388 technical committees are now at work developing new standards, and it points out that about 10,000 people are directly involved.

THE adoption of standards depends primarily on economics. Even the initial work of developing standards usually stems from some long felt need for simpler or cheaper ways of doing things. Whether or not the code catches on depends on how well it does its job. Most, because of the vast experience of the men working on them, will do much to save an individual company a great deal of money. H. W. Christensen, director of purchases, Columbia-Geneva Steel Division, U.S. Steel Corporation, San Francisco, Calif., described in a recent talk his division's experience with standards. Within 1 year, a standardization program eliminated 22 percent of the items carried in several commodity classes and reduced the purchasing cost of some items by 30 to 40 percent.

Economies most often result from large scale production of a standardized product It stands to reason that volume production of one item will result in a lower unit cost than small runs of a great many units differing only slightly from each other. Retooling costs are saved as well as expenses for training personnel in new methods.

Some of the most striking savings resulting from standardization are to be seen in the railway industry. Were it not for the universal use of the 4-foot 8½-inch gauge in this country and such other standards as car couplers and air brake connections, costs to the railroads, and to their users as well, would multiply many times. Thus interchangeability may be said to be the other great advantage of the use of standards.

An example of what happens to prices when adequate standards aren't available, or aren't used, can be quoted. There is an American Standard for such a simple everyday thing as a street manhole cover. The code has never been widely adopted, yet one foundry man points out that he carries in stock 134 patterns for manhole covers. It is his contention that he could reduce his prices by about 30 percent if only all of his customers used the American Standard.

A need still exists for additional standards. Indeed, every time a new product comes forth, it is possible that new standards must be evolved. The proposed aim of the American Standards Association is to see that standards eventually become tools not to reduce confusion or to meet emergencies but to forestall confusion and prevent problems from arising. American industry is learning that it is in the best interests of profits to support standardization programs.

20 YEARS OF SERVICE
FIGHT INFANTILE PARALYSIS
MARCH OF DIMES

SAVING WITH AIR POWER

Air Starting Motors Reduce Electrical Maintenance

TO REDUCE problems of electrical maintenance and parts supply, air starting motors are being installed in 69 heavy-duty trucks being built by Dart Truck Company of Kansas City, Mo., for mining operations in Peru. These 25-ton end dump trucks and another six 10-ton Darts are a portion of a 90-vehicle, $2,500,000 order, that is believed to be the largest off-highway truck order ever placed. They are being delivered to Southern Peru Copper Corporation, a combine of four major copper companies, and will be used in development of the huge Toquepala and Quellaveco copper deposits.

DART ORE TRUCKS FOR PERU

In 1951, a 35-ton, 3-axle end dump truck (above) was equipped with a 335-hp diesel that was cranked by a 9BM Ingersoll-Rand air starter. From this first, pneumatic starters were available as optional equipment on many Dart models. So successful have they been that they were used on the vehicles that were sent to Southern Peru Copper Corporation. Two of the 25-ton ore trucks are shown (below) at the Port of Houston, Tex., being loaded for shipment. They are part of a $2,500,000 order.

The trucks are destined for a demanding job, working in rough terrain, high in the mountains, at altitudes from 9000 to 12,000 feet. They will work around-the-clock, stopping only for fuel, routine maintenance, shift changes and the like. This is a 2-part project: for an estimated 5 years, the trucks will handle overburden; when this is stripped, they will haul ore to the concentrators.

In service such as this, in an isolated mining operation, maintenance is often a problem and parts supply is difficult and expensive. Dart has designed and built trucks that can take rough treatment with a minimum of upkeep. In line with this policy, air starting motors were specified to reduce electrical care, particularly battery replacement.

Each 25-ton vehicle is powered by a 335-hp diesel. To start it, if an electric motor were used, two heavy-duty 12-volt batteries and a series-parallel switch would have to be provided for 24-volt electric starting. Instead, all of the trucks are equipped with Size 9BM Ingersoll-Rand air starting motors. These use compressed air supplied by the regular brake system compressor. Thus, electrical requirements are reduced to those of lighting and gauges; a single 12-volt battery can meet these needs and carries less load and lasts substantially longer.

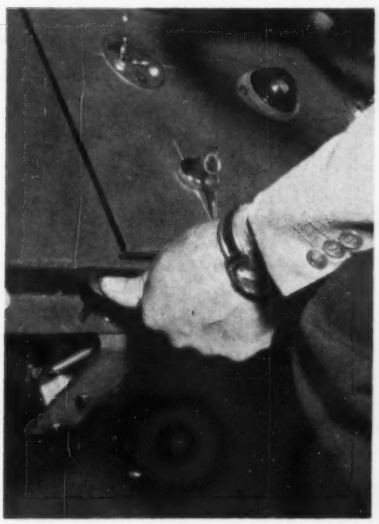
Based on experience in other mining operations, Southern Peru engineers expect air starting to cut battery replacement at least 75 percent, an especially important saving when it is considered that the batteries have to be hauled up into the mountains. Other elements of electrical maintenance also are expected to show improvement. Generators have less work to do and stand up better. Air motors require little, if any, repair as compared with regular replacement of electric starter armatures.

Dart is one of the pioneers in the application of air starting to off-highway vehicles. The first truck equipped with a 9BM Ingersoll-Rand air starter in 1951 was the Model 35T, a 3-axle, 35-ton end dump truck powered by a 335-hp diesel. In the ensuing years, air starters were made available as optional equipment on other models. Today, every truck in the line, from the 10-ton to giant 55-ton units, can be obtained with air starting. Success of these units in the field led Dart to specify pneumatic starting motors as standard equipment. Thus, the new Model 35 SL, a 35-ton end dump truck powered by a

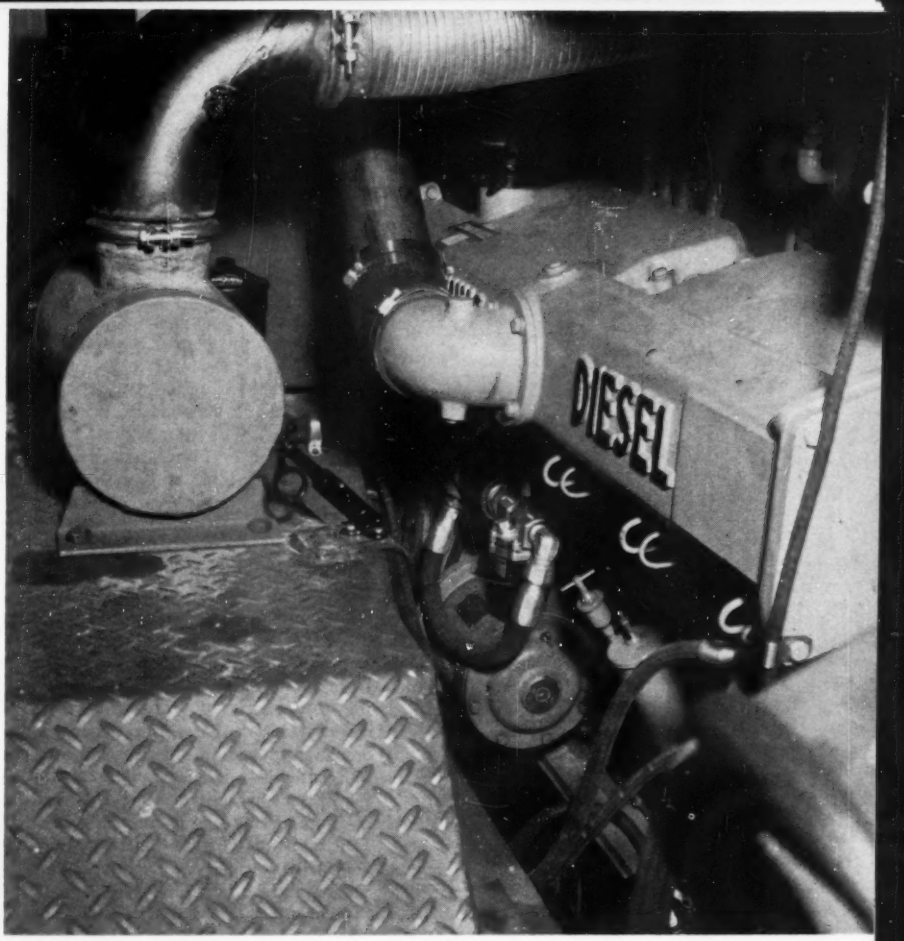
400-hp Cummins diesel, is regularly equipped with a 20BM Ingersoll-Rand starter. It was natural, then, that this type of starter should be specified for the Peruvian order.

The 25-ton truck is normally equipped with an air compressor and three tanks to provide air for braking. To supply an ample quantity of compressed air for starting, a 16x16-inch cylindrical receiver was added to the system. Strength was deemed more critical than weight, thus it was made of steel. From the compressor, air goes through Aeroquip hose and ¾-inch copper tubing to the first brake supply tank. Then one line supplies the second brake tank while a separate length of hose carries air to the starter supply reservoir. Air from this flows to a 1-inch Hy-trol valve controlled through a loop of hose by a push-button-operated Schrader valve on the dash board. From the Hy-trol valve, air goes through a Norgren lubricator set in a bypass loop.

Operation is simple and standard. Just a push on the dash-board button cranks the diesel. Piping is arranged so that air from the brake system can be utilized in starting. This has proven

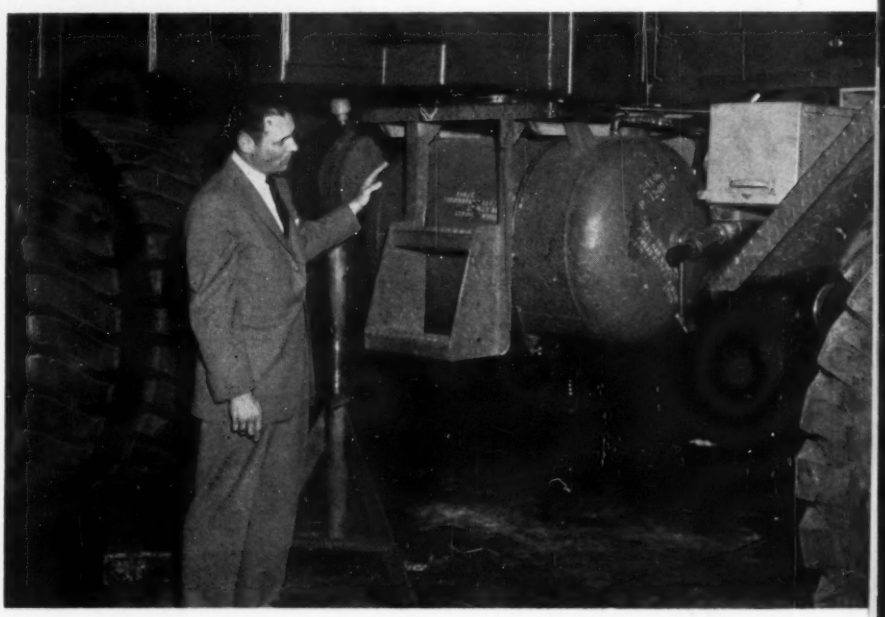


sound in operation since the brakes always are locked before the engine is started and would remain locked if air were exhausted. Drivers don't release the brakes until air pressure has been restored. In practice, the starter supply tank alone usually has plenty of air for several consecutive starts. Then pressure quickly builds up as the engine runs. If air is exhausted for any reason, it is a simple matter to pump it in, either in the shop or the field, through a Hansen Push-tite coupling on the starter system. With 24-hour operation of the vehicles, Southern Peru expects no more than eight or ten starts a day, and there should be plenty of air in the receivers.



PNEUMATIC SYSTEM

The closeup above shows a Size 20BM Ingersoll-Rand air starting motor installed on a Dart Model 35 SL truck. Air is drawn from the standard brake system and is held in a cylindrical steel receiver (below). It flows from there, through Aeroquip hose to a Hy-trol valve that is controlled through a loop of hose by a push-button-operated Schrader valve on the dash board (left). Air then goes to the starter through a Norgren lubricator (located directly above the starter in the picture above) set in a bypass loop.



STATION, DISNEYLAND

Typical of Disneyland's attractions is this station house for the Santa Fe & Disneyland Railroad. The line encircles the park. Both passenger and freight trains are in service, and each can accommodate 300 people. Two engines are used and are replicas of 1890-type steam engines. The complete run covers a distance of 1⅛ miles. Problems of maintenance and safety are as vital here as they are in such other modes of "transportation" as a 105-foot paddlewheel river boat "Mark Twain," and explorer's boat that travels through Adventureland.

Subaqueous Maintenance At Disneyland Promotes Safety

IT HAS been more than 2 years since Disneyland was opened to the public. Operations run 7 days a week, 13 hours a day, during the peak season; and 6 days a week, 9 hours a day, during winter. Since July 18, 1955, more than 6 million people have visited the make-believe land. They flock to see the past and future at a daily rate of about 4000 in the wintertime, and at more than five times that rate during summer days. COMPRESSED AIR MAGAZINE told the story of the playground last November when maintenance problems were essentially unsolved. Now those initial obstacles are becoming matters of routine care. To keep the park going, the maintenance and construction staff varies from 250 to 300 skilled artisans, depending on the time of year. "Down-time" on any ride or attraction means a decrease in attendance and a resultant loss of income. It is therefore necessary to maintain a repair program to keep the equipment in operation. Of primary consideration is visitor safety, both in the streets and byways, and in the 41 various attractions.

Most of the equipment in use was new in every sense of the word. Unlike the designers of industrial machinery, the creators of Disneyland did not have previous models and performance results from which could be derived load, drive, lubrication and similar data. As a result, they are constantly conducting research to increase repair efficiency.

Typical of the results of this program is the solution to the problem of checking and repairing underwater devices. Boats operating on narrow streams form a large portion of the transportation system. These run on underwater guide rails. They are inspected daily, along with their driving mechanisms, by divers wearing Aqua-Lungs. At the same time, the lubricants are inspected to be sure that the water has not affected them. Should repairs be necessary, drums are filled with water and are sunk near the apparatus. Once they reach the bottom, they are positioned underneath the equipment, and the water is pumped out. As they float to the surface, they carry their "cargo" along. Repairs are made, and the units are resubmerged.

Swedish Engineers to Attempt—

Salvage of 300-Year-Old Man-of-War

AFTER 300 years of being under 18 fathoms of water, the Swedish man-of-war *Vasa*, may be successfully salvaged. The vessel foundered on her maiden voyage without even having left the inlet to Stockholm. It is expected that the ancient hull will be made to float again and thus become a unique cultural find.

The *Vasa* was a large, first-rate ship of Galleon type in the fleet of king Gustavus Adolphus—reigning during that period of history when Sweden was one of the Great Powers of Europe. She had three decks and carried no less than 60 to 70 bronze cannon, most of them weighing about 3 tons, which probably made her top-heavy. She was a fully equipped warship on her way to a known mission when, in 1628 and with 400 persons on board, she foundered, struck by a sudden blast of wind.

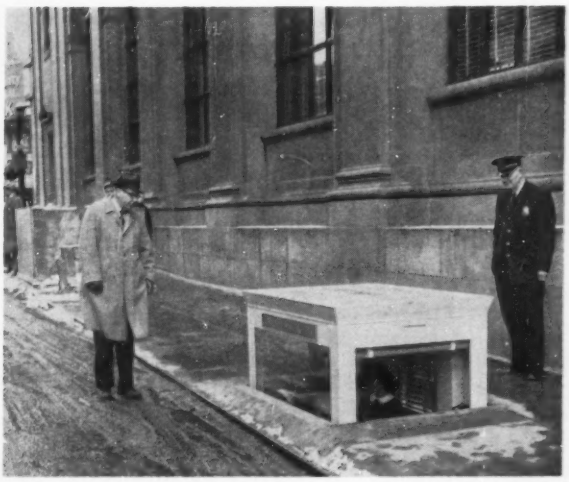
There do exist other ships of much older standing that have been brought back from the sea. Egyptian sunboats, Caligula's galleys and Norweigian Viking ships are examples, but the *Vasa* is probably the oldest, fully identified craft found in such good condition. She is exactly dated and records concerning her construction, equipment, crew, etc., have proved very comprehensive. There also are exhaustive records concerning early attempts at salvage undertaken in the years after she foundered.

The records of these mid-seventeenth century diving operations are very interesting. Today, underwater television and scientific diving equipment facilitate the work of the salvage crew, but in those days diving operations at such depths were probably unique. What is more, some of the valuable heavy bronze armament was salvaged at that time, at least seventeen of the cannon being cleared and brought ashore by means of a diving-bell. Some of the superstructure of the *Vasa* which is missing above the upper deck, was presumably also removed at that time. Even so, her poop deck will still be about 40 feet above the water line.

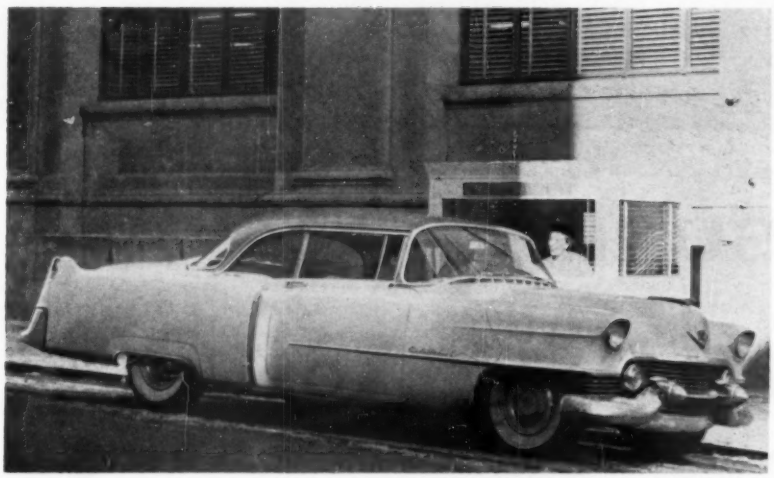
The *Vasa* was a richly ornamented vessel, according to the customs of the time. Many carved jeer-bits have been observed on the ship, and one of its masts carries carved ornamentation. The most interesting object so far carried to the surface is a sculptured 13-foot-long wooden prow device. It had been immersed in mud that surrounds the ship. The mud may possess certain preserving properties, for the man's head which tops the sculpture—possibly portraying the old Viking god Odlin—carries its original vivid expression even to small wrinkles around the eyes. Traces of gold can also be observed.

Although the approximate location of the wreck has long been known, the honor of having certified its exact position is due to an amateur archaeologist, Anders Franzen, who devoted many years to the study and research that led to the present salvage enterprise. The diving operations and a system of vacuum removal of mud from the decks are in the hands of the Royal Navy's diving forces.

The *Vasa* is built entirely of oak. The latter material, and the ship's location at sufficient depth, have protected it from many of the ravages of time and climatic conditions. She has not been damaged by salt water, ice, currents or tides, plant or animal life, and the even temperature and pressure of the surrounding waters have helped preserve the hull. The final lifting is expected to take place this spring.



COMMUNITY NATIONAL BANK GETS A LIFT



TO MEET the ever developing need for easily accessible banking facilities, the Community National Bank of Pontiac, Mich., is "rising to the occasion." The elevator bank, illustrated in operation on this page, emerges from the sidewalk at 9:00 a.m., vanishes below the sidewalk level for a change of tellers at 1:30 in the afternoon, and drops out of sight at 6:00 p.m. When in the lowered position, the top of the teller's cage becomes an integral part of the sidewalk. The novel banking facility has proved so popular that a second unit is being installed.

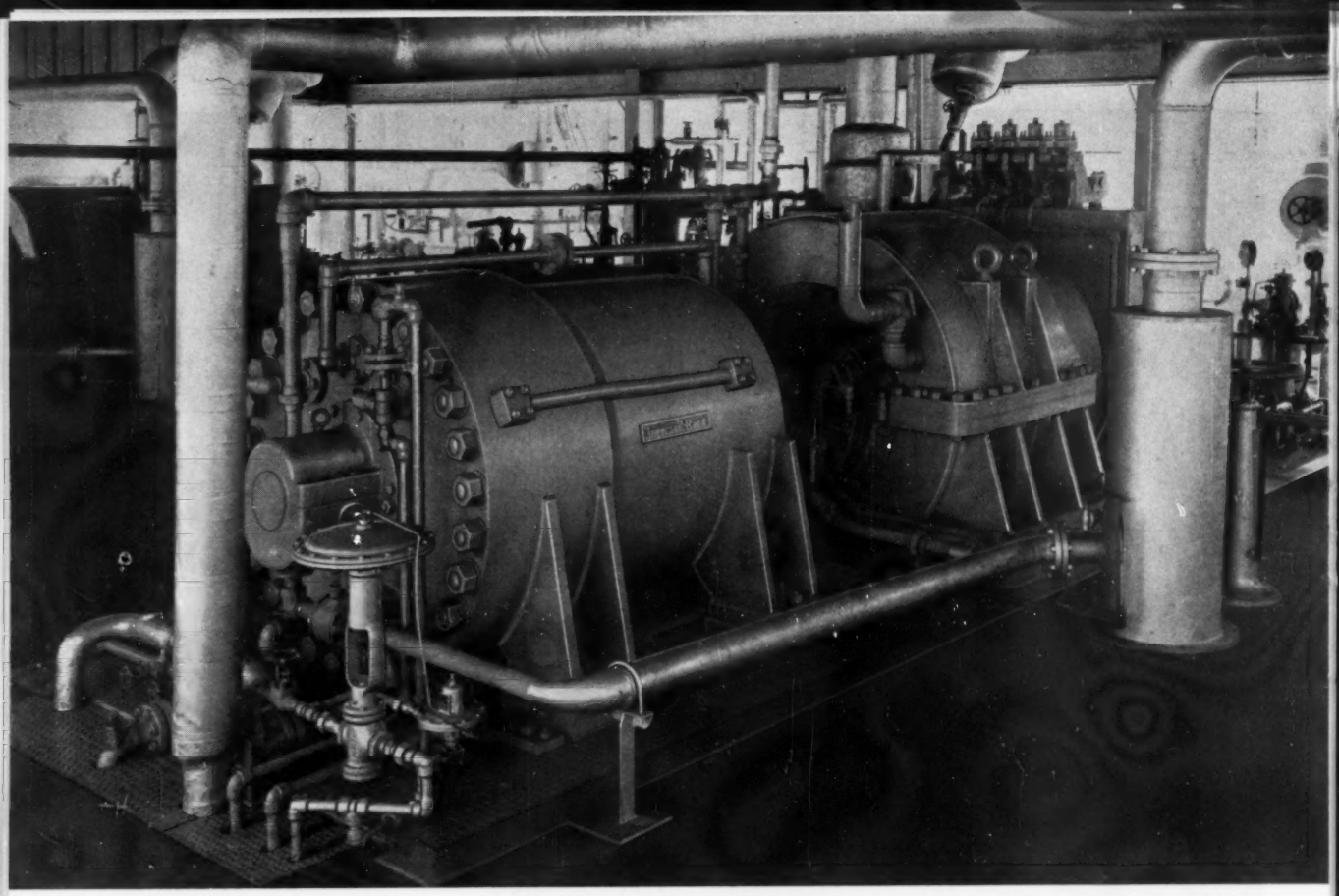
The Snorkel, as it is called, is 7 feet high, 6 feet wide and 4 feet deep, and was designed as a result of a lack of space for the usual drive-in type of opening. It was installed by The Mosler Safe Company and the Haughton Elevator Company of Detroit, Mich. Basically, it is a bullet-resistive glass and steel booth mounted on an elevator mechanism, the latter consisting of a screw-lift, V-belt-driven machine. Control equipment is of constant-pressure pushbutton type.

Pneuma-Serve Reduces Fastening Time

GEO. A. Tinnerman Corporation of Cleveland, Ohio, has developed an automated fastener-feeding device called Pneuma-Serve. The model accommodates screws with any type of preassembled washer. It incorporates a selective release mechanism that accurately controls the entry of fasteners into the delivery tube. Oversize or misshapen screws that would not clear the feeder mechanism are automatically trapped on entering the release block. From there they are ejected by a pneumatic blow-out device. The button that actuates this mechanism is normally located at the base of the hopper; however, the design is such that it can be mounted at any bench position or on the barrel of the driver itself. It is estimated, by the manufacturer, that the air-operated equipment will save on the average of 4000 hours in driving time for every 3,000,000 screws previously hand placed and power driven.

FASTENING OPERATION

Use of the automated Pneuma-Serve screw-feeding device at Vanity Fair, Inc., has reportedly been responsible for a 40-percent saving in the time required to attach operating mechanisms of toy phonographs in their card-board carrying cases. It only takes 12 seconds to drive these four No. 6x5/8-inch type A slotted-washer-head sheet-metal screws. The equipment is capable of handling virtually all types of screws, including those with preassembled washers.



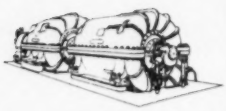
Putting the PRESSURE

on low-grade naphthas

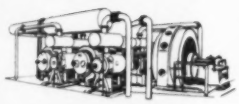
to make high octane blending stocks

THE Ingersoll-Rand centrifugal compressor shown here handles hydrogen gas at high pressure – 5050 cfm at 675-psia discharge pressure. Driven by a 6340-hp I-R steam turbine, it is one of two duplicate machines installed as recycle compressor on a large catalytic reforming unit. This same refinery uses 19 additional I-R compressors.

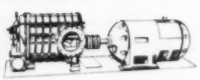
Ingersoll-Rand compressors are industry's first choice for high-pressure operation. Centrifugal compressors like the one shown here are now operating at pressures over 2,000 psi; I-R reciprocating compressors have been sold for pressures as high as 35,000 psi. So if your process calls for *putting on the pressure* you'll want to look into the complete line of I-R compressors. There's one that will be *just right* for your application. If necessary, a compressor can be designed specially for your application. Ask for your copy of form 3132-A, Process Compressors.



CENTRIFUGAL



RECIPROCATING



AXIAL-FLOW ROTARY

EJECTOR-JET

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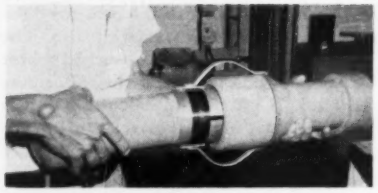
PUMPS • COMPRESSORS • DIESEL ENGINES • AIR & ELECTRIC TOOLS • TURBO BLOWERS • CONDENSERS

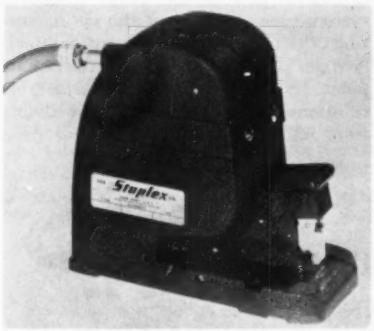
Industrial Notes



B. F. Goodrich Industrial Products Company has developed a "quick" coupling that can reportedly be assembled and disassembled in seconds. Made of Koroseal polyvinyl chloride pipe, the device is recommended for temporary chemical, oil, water or disposal lines. To make the connection, a simple push-pull operation is required. Once it is made, it is said that it will withstand high pressures. The coupling will fit as much as a 10-degree misalignment in pipe joints. It is available in 2-, 3- and 4-inch sizes in standard 20- and 30-foot lengths.

Circle 1E on reply card

For fast, low-cost stapling jobs, The Staplex Company has developed a pneumatic machine that can perform a variety of industrial fastening applications any place where shop air lines are in use. Model SA-100, as it is known, is equipped with a 3-way air switch valve for either foot, knee or hand operation. It is said to be easy loading, using standard ¼-inch leg staples, there being nothing to remove for this operation. Although it weighs only 7 pounds, it is made of sturdy dural casting for easy bench mounting and is available ready for use.



Circle 2E on reply card

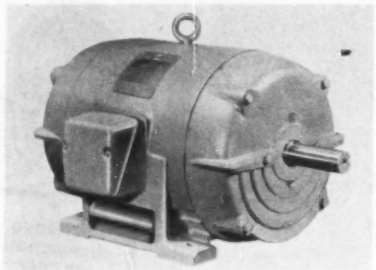
Natural polyethylene tubing in standard 100-foot coils is available as an "off-the-shelf" item from American Agile Corporation. Measuring 1 inch in outside diameter, the hose is designed for transmitting liquids such as those for human consumption in beverage dispensing equipment, for acid handling in laboratory and production operations and for other handling of corrosive media.

Circle 3E on reply card

Packaged, carbon-dioxide fire extinguishing systems for industrial spaces containing normal flammable liquids have been announced by Walter Kidde & Company, Inc. They contain all the components needed to install an automatic system that will protect rooms of from 140 to 6000 cubic feet in capacity. One or more carbon dioxide cylinders, rate-of-temperature-rise fire detectors with connector tubing, automatic control and discharge heads with a manual actuating device, Multijet discharge nozzles, cylinder supporting frame and instructions are included. Pipe and fittings for each size system, packaged in individual boxes, can be ordered separately, as can accessory items such as remote control pull boxes, alarms operated by the pressure of the discharging carbon dioxide, and other pressure-operated trips and switches used to close doors and windows or turn off electrical equipment and machinery. All operating parts are enclosed for safety, and they require no outside power source.

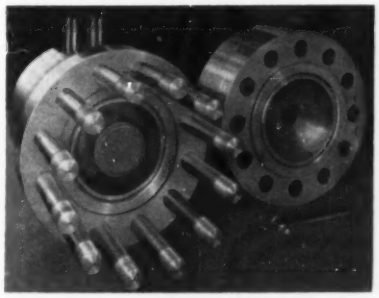
Circle 4E on reply card

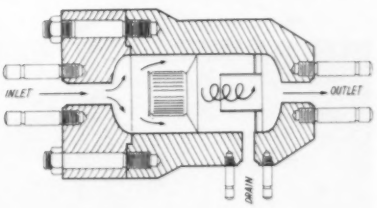
Syncro-Spede is what is said to be industry's first synchronous induction motor built in the same NEMA frame size as a standard motor of equal horsepower. Developed by Louis Allis Company, it accelerates as an induction motor but runs at exact synchronous speed without permanent magnets or direct-current excitation involving collector rings and brushes, wound rotating fields and the like. The unit is compact and is suitable for use on many applications requiring constant speed with varying load. Because of its size, it can provide precise frequency systems in small generator ratings. Ratings for the motor range from 1 to 100 hp, and it can be foot- or flange-mounted either horizontally or vertically with a wide range of mechanical modifications to meet specific application requirements.



Circle 5E on reply card

Purifiers that are said to withstand pressures as great as 15,000 psi in applications in chemical, petroleum, synthesis gas, petrochemical, fertilizer and air reduction plants, as well as other high-pressure industries, are being marketed by The V.D. Anderson Company. The units have no moving parts, filters or mesh screens of any type, but operate by means of a 2-stage principle of separation that makes use of carefully controlled centrifugal force to guide the gas and any entrained solids or fluids through a series of vanes and baffles. In the first stage of separation, impingement against a baffle removes larger droplets. In the second phase, the purifier removes fine mist by utilizing centrifugal scrubbing action through a uniquely designed separation element. Extremely small units reportedly function without danger of carry over under normal operating conditions.



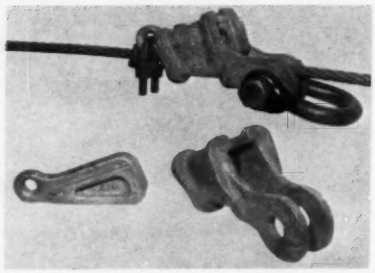


Circle 6E on reply card

At a glance, the actual hours and minutes of engine operation can be determined with John W. Hobbs Corporation's hour meter. Both pointer-type and direct-reading varities are available for equipment powered by internal combustion engines such as air compressors, irrigation pumps, diesel locomotives, air conditioning and refrigeration units, motor boats, tanks, tractors, trucks and

earth moving equipment. Both direct and alternating current types are available. *Circle 7E on reply card*

For car pulling, barge moving, rigging or similar operations where a load must be connected to a line, Sauerman Bros., Inc., provides a quick way of attaching it to a continuous cable by using a 3-part fitting. The fixture consists of a wedge clamp, wedge and cable clip. To

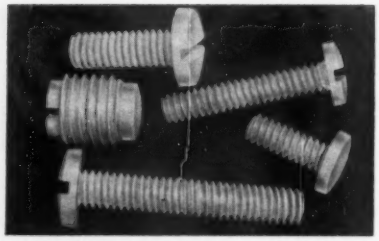


attach the load to the cable, the wedge clamp is placed on the cable with the small end in the direction of the cable pull. The wedge is then inserted. The cable clip passes through the eye of the wedge and locks it in place. A clevis and pin are frequently used to attach the load to the clamp. Units are manufactured for rope sizes from ⅜ to 1¼ inches. *Circle 8E on reply card*

Chemical dehydrators for drying compressed air, filter air, remove soluble vapors and are self-cleaning in normal use. Air is forced into the unit near the bottom and discharged near the top. The dissolved chemical and absorbed water vapor is discharged from the bottom as a liquid. Commercial calcium chloride flake that not only absorbs large quantities of water, but wastes away as a very dilute solution, is used. It may be obtained, from builders' supply dealers in 25- and 100-pound waterproof bags at a cost of a few cents a pound. The dehydrator, manufactured by H. J. Kaufman Company, is portable and reportedly will operate at all atmospheric temperatures without requiring exterior services such as heating or cooling.

Circle 9E on reply card

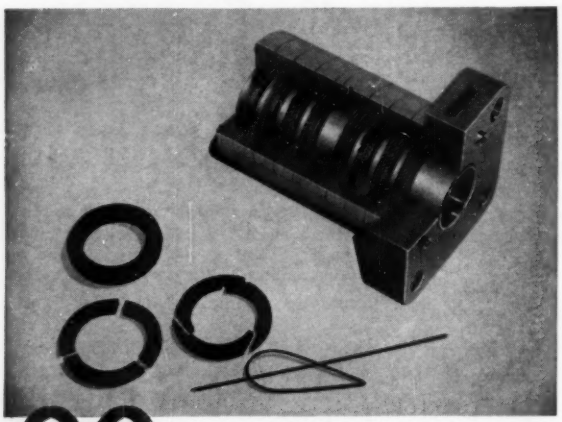
Nylon screws molded one at a time introduced by Gries Reproducer Corporation are uniform, and are ideal for applications where closely held tolerances are important. Initial stock sizes for machine screws are 6-32, 8-32 and 10-32, ranging in length from ⅜ to 1 inch. Headless set screws are also available. All fasteners are identical in all dimensions and are made at a low cost because no hand work is involved in their manufacture. They are molded and trimmed free of flash, ready to use, on fully automatic machines using single-



cavity techniques. They have electrical insulating value and a natural resilience that allows them to be used in vibration-proof assembly without recourse to lock washers or other separate devices. Further, they are nonmagnetic, nontoxic, fungus proof, and reportedly will retain their shapes even after sterilization.

Circle 10E on reply card

An adjustable gauge protector designed to limit maximum pressure on air or oil gauges has been announced by Superior Hydraulics Division of Superior Pipe Specialties Company. When installed, the device is said to automatically cut off flow to the gauge whenever system pressures exceed the spring setting of the unit. It reopens automatically when pressures drop below the cutout point. The spring is manually adjustable to permit setting for any desired closing from 50- to 300-psi pressures, or from



Look to COOK for Better
CARBON PACKING RINGS!

Cook carbon packing rings are made of a special carbon graphite material that automatically assures you *high resistance to wear, chemical inertness and excellent heat conductivity.*

If you have sealing requirements for non-lubricated compressors, write today for a sample carbon ring, plus literature on Cook's complete line of packing materials. Address C. Lee Cook Company, 930 South Eighth Street, Louisville 3, Ky.

C. LEE COOK COMPANY
Sealing Pressures Since 1888

Circle 16A on reply card

It's the SNAP in this trap that gives you dependable Compressed Air Drainage

ARMSTRONG SNAP-ACTION AIR TRAP

No Dribbling, no air loss when you drain compressed air systems with Armstrong snap-action traps. The spring-powered valve snaps wide open for fast drainage, snaps tightly closed before all water leaves trap—always a perfect water seal. Fine dirt and grit can't lodge in valve and cause leaks. Recommended for use where no heavy oil will reach trap.*

Trouble-free Construction: the flat strip string of special Swedish steel lasts for years . . . valve and seat are hardened chrome steel . . . all other internal parts stainless steel. Cast semi-steel body for pressures to 250 lbs., forged steel for pressure to 1000 lbs.

ASK FOR BULLETIN 2023. Call your local Armstrong Factory Representative or write: Armstrong Machine Works, 8851 Maple St., Three Rivers, Michigan.

*Heavy oil will plug up any ball float traps. Armstrong Inverted Bucket Traps are the answer to this, particularly on intercoolers, aftercoolers and receivers where large, heavy duty compressors are used.

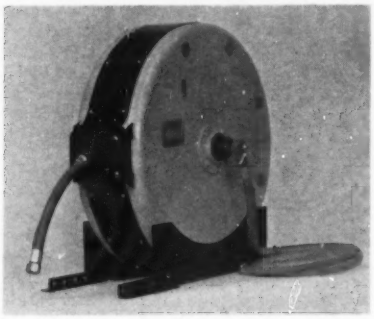
ARMSTRONG SNAP-ACTION AIR TRAP

Circle 17A on reply card

500- to 5000-psi pressures. Small and compact, equipped with ¼-inch NPT port connections, the mechanism can be placed in almost any position on a wide variety of air and oil systems.

Circle 11E on reply card

Model A-2 is the latest addition to United Specialties, Inc., line of industrial hose and cable reels. It has a capacity of 50 feet of ½-inch single hose, and is designed for use with compressed air, industrial gases, liquids and chemicals. Units feature universal-type



mounting brackets that permit easy installation on walls, floors, ceilings or mobile equipment. A heavy-duty, clock-type spring provides automatic retraction when the hose is not in use. Teflon seals are said to assure leak-proof operation at all normal operating pressures. The hose is locked at any desired length by a positive-action pawl and is released by means of a slight tug on the hose.

Circle 12E on reply card

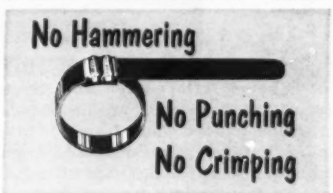
An unusual concept of flow control is featured in General-American Valve Company's Tapered Orifice Valve. By moving a plug with a tapered slot into and out of a circular opening, the flow of fluid or gas is controlled by the area of the tapered slot at the head of the opening. A circular sealing ring is said to eliminate bypass. Replacing the needle valve in nearly all applications, the unit will reportedly pass foreign particles up

"Moves mountains" with the help of
BAND-IT® CLAMPS

This deep hole drill meets extreme abuse as it drills through loose strata and solid rock alike. Tension, flex, surge, high line pressures and great vibration require ultimate in hose clamp. The manufacturer meets these requirements by using BAND-IT JR.* clamps on hose of these rugged machines.

IF YOURS IS A TOUGH CLAMPING PROBLEM, SOLVE IT WITH BAND-IT CLAMPS

The BAND-IT tool—BAND-IT band and BAND-IT buckles are all that is required to form clamps of any diameter from continuous roll of stainless steel BAND-IT band, without waste and in only a few seconds.



BAND-IT Jr., stainless steel preformed clamps in 18 sizes for ¼" to 6" diameters are applied with ease in seconds, using only the BAND-IT tool and adapter. For production clamping we offer the BAND-IT air tools.

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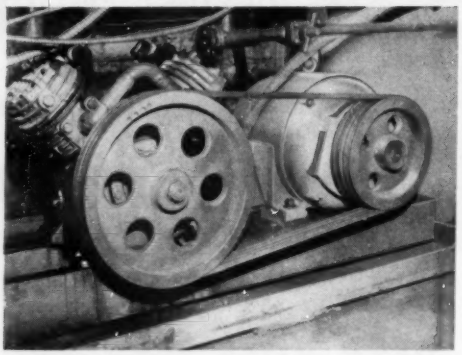
BAND-IT CLAMPS GO 'ROUND THE WORLD

Circle 18A on reply card

TEAMWORK!

BROOK A. C. MOTORS AND YOUR COMPRESSORS



BROOK A. C. MOTORS provide a smooth flow of power to compressors regardless of climatic conditions. Brook Motors, 1 to 600 HP, cost less initially and assure maximum service life and overall economy. There is no finer motor built. They're powering air and gas compressors from Arabia to Wyoming, stacking up splendid performance records. There's a Brook Sales and Service Headquarters near you. Send for literature.

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world's most respected motor

BROOK MOTOR CORPORATION

3553 W. PETERSON AVE., CHICAGO 45, ILL.

BROOK MOTOR CORPORATION

Circle 19A on reply card

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.
209 East Park Drive, Buffalo 17, New York

The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

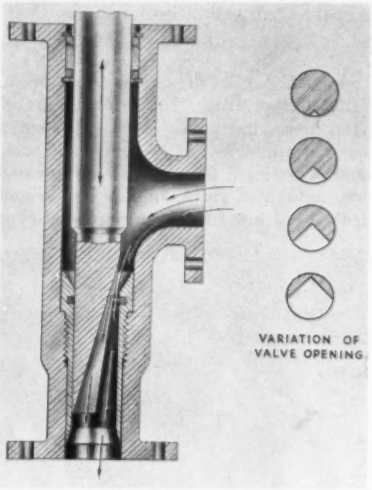
For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

Circle 20A on reply card

to twenty times larger than comparable needle valves. After field tests in such industries as petroleum production, air-



craft, diesel engine, chemical production, mining, and the like, the designers state that the principal advantages are that it offers highly accurate, infinitely variable control, is nonclogging, nonfreezing and abrasion resistant and has a good coefficient of flow at all settings with very low turbulence. The units are available in a variety of sizes, pressure ranges and connections.

Circle 13E on reply card

Bright and uniform illumination, free from shadows and bright spots, are given from Edmund Scientific Company's Industrial Bright Beam Lamp. Optically designed for all close-work operations, it is said to increase production and to reduce errors and spoilage. Ruggedly constructed, vibration resistant, this unit features a mechanical adjustability that enables it to be placed in practically any position for the most convenient

and best illumination. Applications are possible in a wide variety of fields such

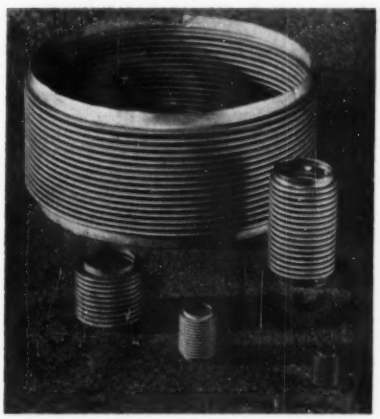
as layout, profile grinding and milling, engraving, filing, sharpening, assembly of small parts, inspection of surfaces, finishes, threads, optical surfaces, etc., as well as use in conjunction with stereoscopic and dissecting microscopes, toolmakers' microscopes, magnifiers and loupes. Spots of light obtainable range from an intense 5/8-inch diameter to about a 3-inch one by simply sliding a focus tube back and forth.

Circle 14E on reply card

Porous grinding wheels that utilize minute balloon-like particles or brittle sponge-like rigid materials that break away to form "air conditioned" voids in the cutting surface when the wheel is in use, have been developed by Electro Refractories & Abrasives Corporation. They reportedly make possible better control of pore uniformity in denser hot-pressed, resin-bonded snagging wheels as well as the manufacture of much more porous, cool, cutting wheels and segments. In the latter case, the balloon-like particles act as pore supports to prevent slumping during the melting of the resin bond prior to hardening in the bake ovens.

Circle 15E on reply card

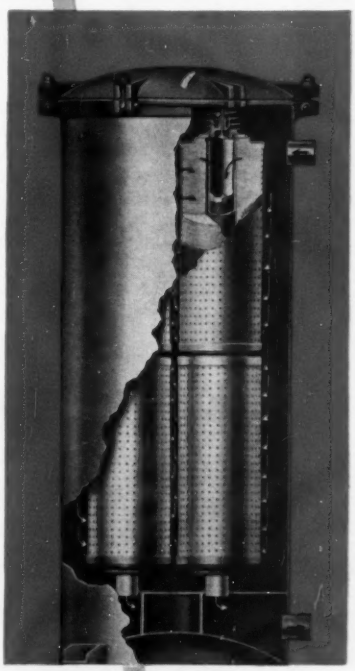
Metal bellows of Inconel and Inconel-X, to meet difficult requirements in high-pressure and extreme-temperature applications have been developed by Fulton Sylphon Division of Robertshaw-Fulton Controls Company. Inconel, a nickel-chromium alloy, is said to possess exceptional strength and resistance to corrosion at high temperatures. Inconel-X, an age-hardening type of metal, features stability. Bellows made of this are especially suited to applications in which precise response must be repeated many times over an extended period. A wide variety of sizes are available from 15/32- to 12-inch outside diameter; the smaller one being made seamless, and the larger ones, of welded construction. They may be obtained in single to four plies.



Circle 16E on reply card

Here's the way you SAVE MONEY with HILCO OIL MAINTENANCE EQUIPMENT!

...KEEPS YOUR OIL AND EQUIPMENT CLEAN AT LOWEST COST



FILTER

Furnished in capacities from 0.1 to 750 gpm. Various cartridges available for mineral and inhibited detergent oils.

HILCO Purification Means *Complete* Oil Purification...

You get absolute removal of sludge, acids, carbon, water and fuel dilution with the correct HILCO for the job. Clean oil saves you money. Expensive maintenance is reduced, equipment shutdowns practically eliminated. HILCO continuous, all electric, automatic purification keeps your oil clean and in top condition at all times. You get full capacity and economy of your equipment.

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New HYSTER Space-Saver® LIFT TRUCKS are Powered by CONTINENTAL

New series includes 6000 (illustrated), 7000 and 8000-lb. capacity models.

Outstanding specialists in two fields have teamed their engineering and production experience to power this new series with a customized engine built specifically for lift truck service. Functionally designed by Henry Dreyfuss, with operator comfort and convenience as a major consideration, the new lift trucks combine ease of handling with high productive capacity and long life. Like so much of the modern equipment speeding the world's work today, they offer that extra assurance of lasting satisfaction, engineered-to-the-job Continental Red Seal power.

ANY EQUIPMENT IS BETTER EQUIPMENT WITH DEPENDABLE CONTINENTAL POWER

Continental Motors Corporation
MUSKEGON • MICHIGAN

Circle 22A on reply card

BRIEFS

Skin divers can now enjoy 60-minute trips at depths of 100 feet with Power Diver, a cigar-shaped, self-powered propulsion unit. Manufactured by Link Aeronautical Corporation, it is easily steered by fingertip movements. Under water, the driver weighs only 1½ pounds. It is 43 inches long and is powered by either a 6- or 12-volt aircraft battery.

The General Electric Company has announced that successful tests of Spain's first atomic reactor have been completed at that firm's Vallecitos Atomic Laboratory. The reactor is soon to be shipped to the Moncloa area near Madrid and is expected to sustain its first chain reaction in March. The reactor is to be used for physics and medical research and for training personnel in the operation of research and power reactors.

The U. S. Navy, in an effort to reduce the amount of helium lost from its blimps, is encasing its lighter-than-air ships with Dacron. The substance has low-stretch and high-tear-strength qualities, and according to the E. I. du Pont de Nemours & Company, has excellent resistance to weathering, rot and mildew. Reportedly, the use of this fabric, instead of the usual rubberized one, has cut helium losses in half.

Although originally designed for aircraft maintenance work, principles of a "disassembly line," or assembly-line-in-reverse, can be applied to similar maintenance projects. The automatic technique, according to The American Society of Mechanical Engineers, reduces by a considerable amount the cost of previously used methods.

To increase the safety of the Panama Canal, a program has been developed to install an experimental lighting system at Gaillard Cut. The contract calls for 20,000 nonshielded flourescent lights mounted on steel standards that rise about 30 feet above the water level. They will be placed 300 to 400 feet apart along the curve of the cut and on both sides of its ¼-mile approaches.

In keeping pace with phenomenally large numbers, such as those used in the field of finance, The National Cash Register Company has announced the development of an adding machine that is capable of totaling trillions. The 14-column device can add up to 1 cent less than $100,000,000,000,000.

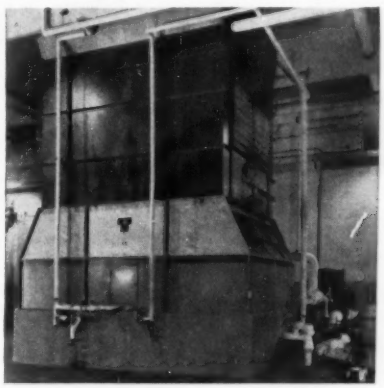
Industrial Books, Films and Literature

Elements of Heat Transfer by Max Jakob and George A. Hawkins has recently been published in its third edition by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Principles and their applications to simple problems remain the volume's basis; newer material has been added to meet contemporary usage. The new final chapter, for example, discusses mass transfer and its similarity to heat. In addition, there are sections on the use of equivalent circuits for the solution of heat transfer problems; additional material for the analysis of engineering systems; and sections that detail the heat of liquid metals in turbulent flow through pipes, the hydrodynamic and thermal boundary layers, convective heat transfer at higher velocities, and the analogy between electrical and thermal circuits for convective heat transfer. Cost, $6.75.

The forty-second annual edition of the *Chemical Engineering Catalog* is now available from Reinhold Publishing Corporation. A standard reference issued for the process industries, it illustrates and describes the equipment of more than 700 manufacturers supplying the field. It contains nearly 2000 pages, and for quick reference has four indexes—Company Catalog, Equipment and Materials of Construction, Engineering Services and Trade Names—and a functional guide, so that engineers and production men can quickly find any desired item. The publication is available free of charge to qualified personnel in the chemical engineering and process fields in the United States and Canada and may be obtained by writing, on company letterhead, to the publisher at 430 Park Avenue, New York 22, N. Y. Engineers in other countries are charged $30 per copy.

Centrifugal pumps, manufactured by Ingersoll-Rand Company and designed for continuous, heavy-duty operation to pressures of 1200 psi, are described in a flier (Form 7148-A) that includes cross-sectional views and a complete table of pump dimensions. The units—the RT, RTS and RTL—are meant for general hydraulic service and are especially suited for steel-mill descaling, mine drainage, pipeline pumping and boiler-feed operations. They are horizontally split, single-suction pumps built with

WHEREVER YOU NEED TO COOL A FLUID... and have a problem of water supply or disposal... use NIAGARA "AERO" HEAT EXCHANGER



▶ Evaporating a very small amount of water in an air stream you can cool liquids, gases or vapors with atmospheric air, removing heat at the rate of input, controlling temperature precisely. Save 95% of the cost of cooling water; save piping, pumping and power. You quickly recover your equipment cost.

You can cool and hold accurately the temperature of all fluids, condense vapors, cool water, oils, solutions, intermediates, coolants for mechanical, electrical or thermal processes. You have a closed system free from dirt. You have solved all problems of water availability, quality or disposal, maintenance expense is low.

You may apply this to solvent recovery, vacuum systems controlling reactions, condensing distillates, cooling reflux products.

For more information, write for Bulletins 120, 124, 135. Address Dept.

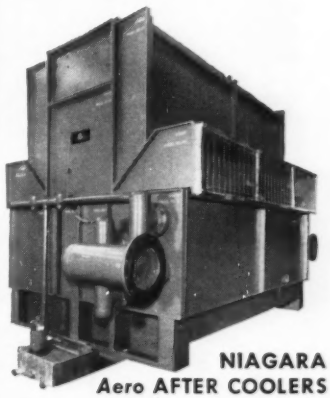
NIAGARA BLOWER COMPANY

Dept. C A - 1, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

Circle 23A on reply card

ECONOMICAL COOLING OF GASES and COMPRESSED AIR



NIAGARA *Aero* AFTER COOLERS

● Cooling gases or cooling and removing moisture from compressed air, the Niagara *Aero* After Cooler offers the most economical and trustworthy method. Cooling by evaporation in a closed system, it brings the gas or compressed air to a point close to the ambient temperature, effectively preventing further condensation of moisture in the air lines. It is a self-contained system, independent of any large cooling water supply, solving the problems of water supply and disposal.

Cooling-water savings and power-cost savings in operation return your equipment costs in less than two years. New sectional design reduces the first cost, saves you much money in freight and installation labor and in the expense of upkeep.

Niagara *Aero* After Cooler systems have proven most successful in large plant power and process installations and in air and gas liquefaction applications.

Write for Descriptive Bulletin 130

NIAGARA BLOWER COMPANY

Dept. C A - 1, 405 Lexington Ave.
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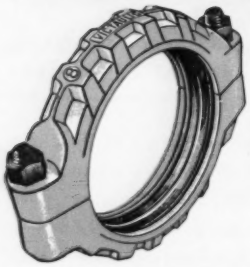
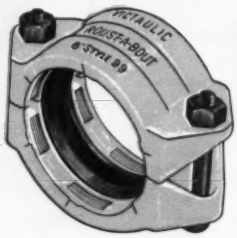
VICTAULIC®

METHOD OF PIPING

VICTAULIC HAS EVERYTHING...



VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

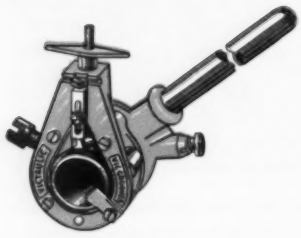


ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB

VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast.
Write for NEW Victaulic Catalog-Manual No. B-1

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Circle 25A on reply card

three, four, six or eight stages for capacities from 200 to 2800 gallons per minute. Heads range between 460 and 2400 feet.

Circle 17E on reply card

Geared flexible couplings in Link-Belt Company's line are described in Book 2775. Included are application and selection data for couplings with maximum bores ranging in size to 7 inches, and ratings, from 2½ to 572 hp per 100 rpm. Uses include standard couplings for close-coupled, direct-driven industrial equipment; spacer couplings to connect shafts that are separated by relatively short distances; units for use with mill motors, compressors, and the like, where one or both of the shafts is tapered; and single-engagement devices, customarily used in pairs with a floating shaft for connection of remote shafts.

Circle 18E on reply card

Men in the construction industry of America, dedicated to the contract method of building, can take advantage of a revised and illustrated edition of a basic booklet, *The Contract Method of Construction Safeguards Public Funds.* First published in November 1948, it has been reprinted many times and has now been rewritten and brought up to date by The Associated General Contractors of America, Inc. For the past 9 years, the publication has been used to inform public officials on local, county, state and federal levels of the many advantages of the contract method.

Circle 19E on reply card

Originally used almost exclusively for aircraft parts, ultra-strength structural steels are now being considered for many other applications where their weight and space saving advantages more than offset their high fabrication costs. They are discussed in a 16-page booklet published by Climax Molybdenum Company with the coöperation of American Iron & Steel Institute, United States firms that are producing these steels and several welding companies. Technical data and a number of tables concerning the composition and properties of these materials, as well as their various end uses, are discussed.

Circle 20E on reply card

Fireproofing tape made of asbestos and silicone by Johns-Manville Corporation is described in a recent publication. It can be used to protect cables in circuits with fast-acting breakers and reportedly stays strong in fire, water, acids and alkalies. The tape meets all public utilities requirements.

Circle 21E on reply card

Designed for use with a variety of air hoses, Hofmann Engineering Company's H-52 Quick-Koupler is available to industry. According to a recent catalogue,

the unit can be furnished in brass, with stainless steel springs and valves, and with a Buna "N" washer. Plugs are furnished in cadmium plated steel or brass so that the device can be used for corrosive fluids. Its serviceability is reportedly dependable to pressures as great as 125 psi.

Circle 22E on reply card

Mining, steelmaking and the manufacture of finished steel products are the subjects of fourteen sound-color motion pictures listed by The Colorado Fuel & Iron Corporation. Each is a 16-mm film with running times varying from 15 to 38 minutes. They are available on a free loan basis.

Circle 23E on reply card

Petch Manufacturing Company recently published a 12-page catalogue of its air and hydraulic cylinders that includes information and engineering specifications regarding five types of cylinders that range from 1 to 10 inches. Special units are available with bores as large as 16 inches.

Circle 24E on reply card

As a service intended to make it easy for designers to specify, and purchasing agents to order, standard-size washers, Associated Spring Corporation has published a revised bulletin listing the dimensions of its more than 1000 different sizes of washer-dies. They are suitable for forming all types of spring materials, both ferrous and nonferrous, and can handle a certain amount of variation in stock thickness.

Circle 25E on reply card

Air Reduction Sales Company, a division of Air Reduction Company, Inc., has issued a 48-page catalogue (Form ADC 848B) of its supplies and accessories for gas and arc welding. Information on ferrous and nonferrous welding rods for oxyacetylene welding and Heliwelding; welding and brazing fluxes and their applications; aluminum welding fluxes; and Aircosil silver brazing alloys is included, as is material about such Jackson and Airco protective equipment as goggles, glare protection spectacles, cap and goggle combinations, welding helmets, face shields and the like.

Circle 26E on reply card

Ampli-Speed is an eddy-current clutch device that provides alternating-current speed changing as well as automatic speed control in applications wherever variable speed is required, as on pumps, printing presses, frequency changers, kiln drivers and the like. It is discussed in Electric Machinery Manufacturing Company's publication 4400-PRD-243.

Circle 27E on reply card

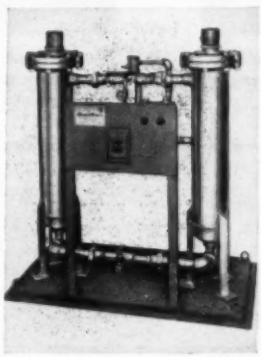
NOW! KAHN offers the NEW!

KAHN HEATLESS DESICCANT AIR DRYERS

Reactivated without heat

Check these advantages:

* Costs reduced on installation and maintenance.
* Steam and electric heaters eliminated . . . reducing utility costs.
* Constant outlet gas temperatures.
* Explosion proofing eliminated.



It's
KAHN DRYERS
all the way . . .

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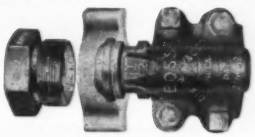
For Those Heavy Duty Air Jobs...

"GJ-BOSS"
GROUND JOINT, STYLE X-34
HOSE COUPLING



The female-type coupling you can rely on for tight, safe connections on the big drills; manifolds; jumbos; in caisson work; and all other high-pressure operations. Copper insert in spud fits rounded head of stem, forming soft-to-hard, leakproof metal seal. "Boss" Offset Interlocking Clamp provides powerful grip on the hose—proof against blow-offs. Also available in washer type, and with companion male coupling. Sizes ¼" to 6".

"BOSS" HOSE MENDER
STYLE BM-16

The practical, safe way to quickly restore damaged hose to service. Complete fitting consists of mender tube and two "Boss" Interlocking Clamps. Tube has flanges to engage clamp fingers. Tube shanks have well-defined, smooth corrugations. Thoroughly rustproofed. Sizes ½" to 6".

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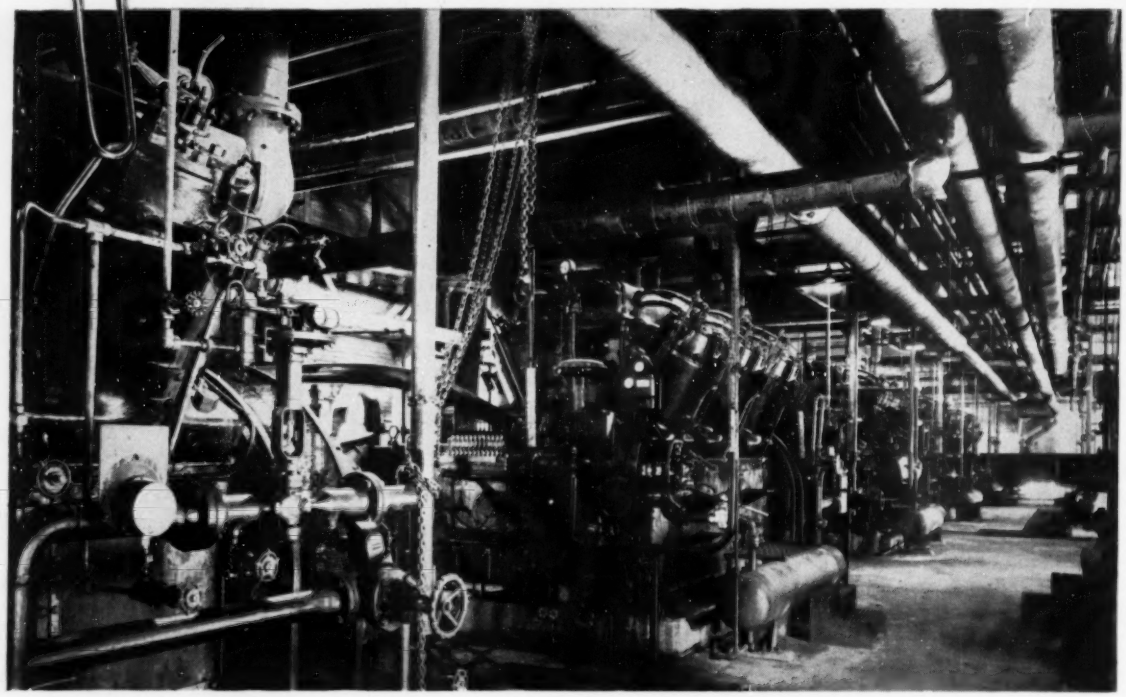
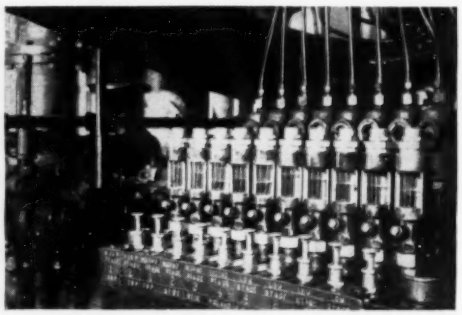
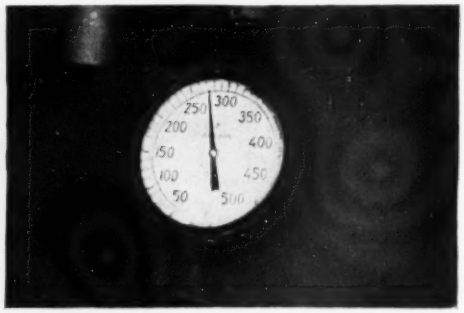


"... Cellulubes were tested for two years in four Air Compressors. Cylinder wear was negligible. Deposits normally found in compressor auxiliaries and valves were reduced or eliminated."



"... A conventional lubricator will pump Cellulubes satisfactorily. No obnoxious vapors—does not present a personnel problem in terms of handling a toxic material."



"... No pressure surges nor evidence of fire in the air accumulator when Cellulubes are used. They are excellent lubricants, and also are effective as detergents."

CELANESE CORPORATION OF AMERICA, CHEMICAL DIVISION
DEPT. 596-A 180 MADISON AVENUE, NEW YORK 16, N. Y.

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Name_____ Title_____

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Application I have in mind_____

From a trial file covering two years testing in 3-stage air compressors

"NO PRESSURE SURGES...NO EVIDENCE OF FIRE... EXCELLENT LUBRICATION...WHEN FIRE-RESISTANT CELANESE CELLULUBES ARE USED!"

"Cellulube has now been in four of our air compressors for approximately two years. The compressors were inspected during a recent Catalytic Reformer General Inspection. Cylinder liner wear was negligible, particularly when compared to the amount of wear we had experienced when previously using a synthetic lubricant. Cellulube, in addition to acting as a lubricant, is also effective as a detergent. Compressor cylinder air passages which had been heavily coated with carbonaceous materials and deposits laid down by the previous synthetic lubricant, are gradually being removed and the compressors again show the original factory finish. Deposits on valve cages and plates have been reduced and are no longer a problem.

"Cellulube does not present a personnel problem in terms of handling a toxic material. There are no obnoxious vapors from Cellulube. A conventional lubricator will pump Cellulube satisfactorily.

"There have been no pressure surges nor evidence of fire in the air accumulator.

"We believe this material is an excellent lubricant plus the fact that acting as a detergent the deposits normally found in compressor auxiliaries and valves have been reduced or eliminated."

These results are typical of what you can expect from Celanese Cellulubes. They have been developed to meet the pressing need for fire-resistant lubricants which virtually eliminate the problem of carbon deposits.

Cellanese Cellulubes are available in 6 controlled viscosities: 90, 150, 220, 300, 550, 1000, S.U.S. @ 100°F. These straight phosphate esters provide excellent lubricity, are non-corrosive and non-reactive.

Celanese Cellulubes open new areas for in-plant protection against fire and explosion. Evaluate them in your own operation. Use coupon to request samples and techincal data.

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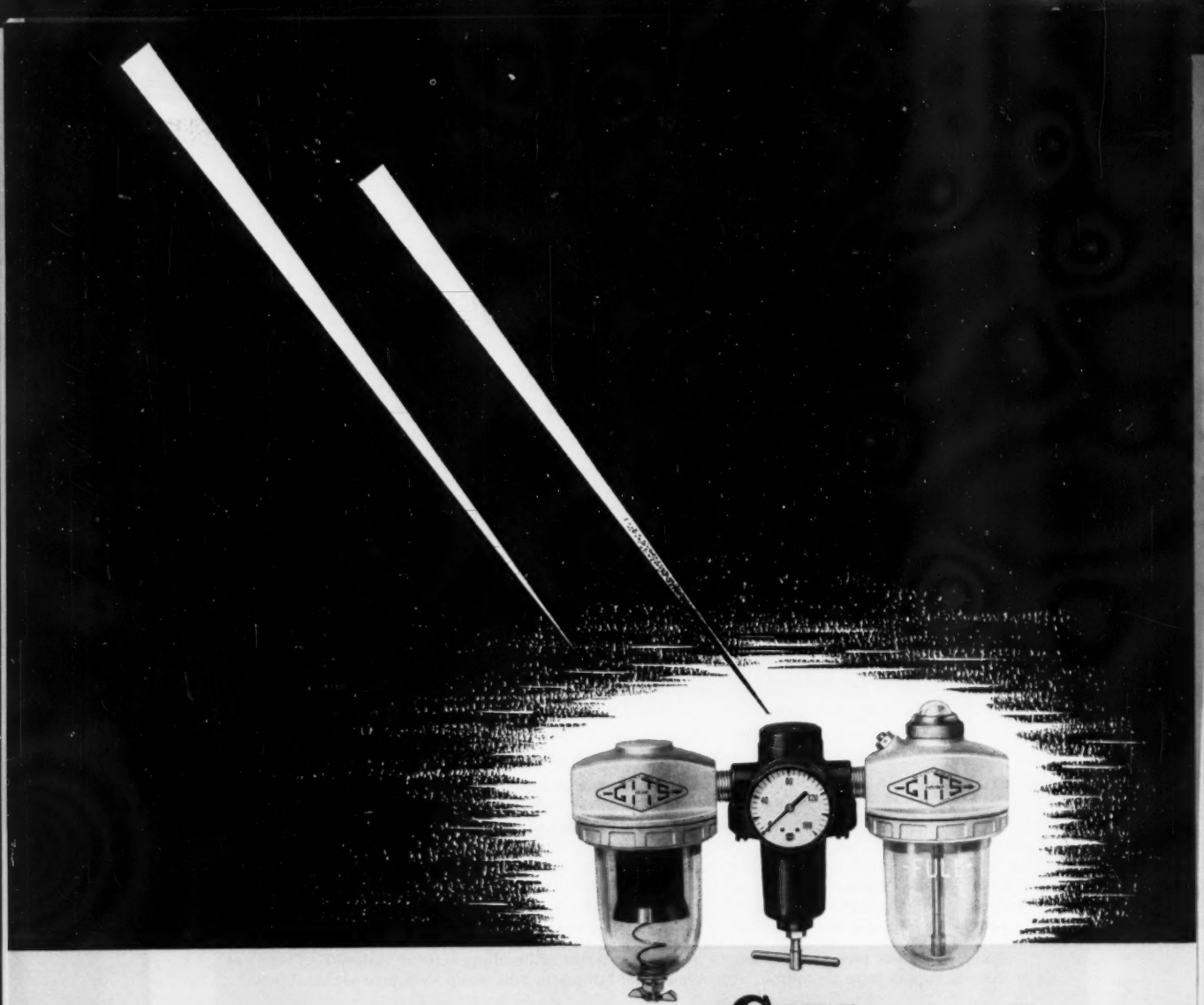
CELANESE CELLULUBES



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Hundreds of 630 Eimcos, powered by air or electric motors, are handling tough materials the world over for mining and other industries. It is the standard in medium-sized, heavy-duty crawler loaders.

The Eimco 630 utilizes many attachments. Equipped with bulldozer blade, it is ideal for underground operations. It works in spots where scrapers cannot be rigged. Other attachments include fork lifts, front-end loaders, jumbo mounts, timber setters and roof bolters. Attachments can be mounted at the factory or in the field.

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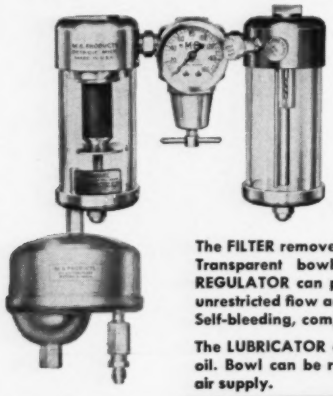
GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



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The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

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Revised and expanded to reflect the significant advances in recent years in the field of centrifugal pumps, this book provides a modern treatment of the whole field. Includes a method of attack based on: a single pattern of flow; identical theoretical reasoning; and similar design procedure for centrifugal, mixed flow, and axail flow pumps.

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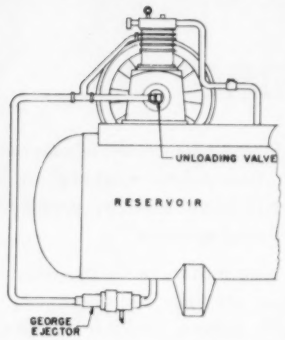

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WIRE ROPE AT WORK

To help satisfy California's growing need for home and industrial gas, a new suspension bridge now carries a 34-in. pipe line across the Colorado River and into the Golden State. The scene shown above was photographed while construction work was still under way. When in full operation, the line will handle an estimated 150,000,000 cu ft of natural gas per day.

The bridge has its easterly tower and anchorage in Topock, Arizona. From tower to tower the span is approximately 900 ft. Among the primary components of the bridge are the 2¼-in. main suspension cables, which were furnished by Bethlehem—prestressed and cut to exact lengths. All in all, more than 17 tons of Bethlehem bridge strand is used in main, suspender, wind, and other types of cables. This application of steel strand, a cousin of Bethlehem wire rope, provides exceptionally strong support for the 70 tons of pipe spanning the river.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:
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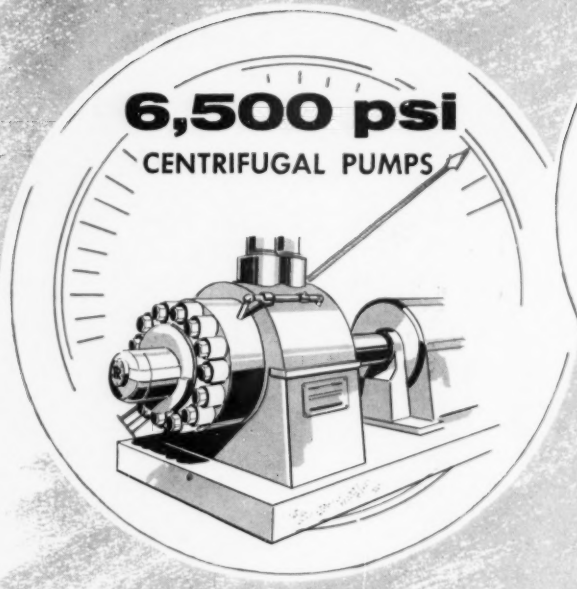
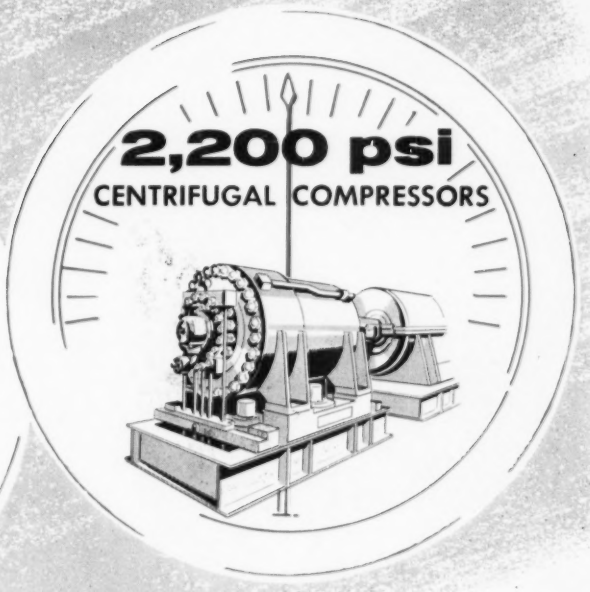
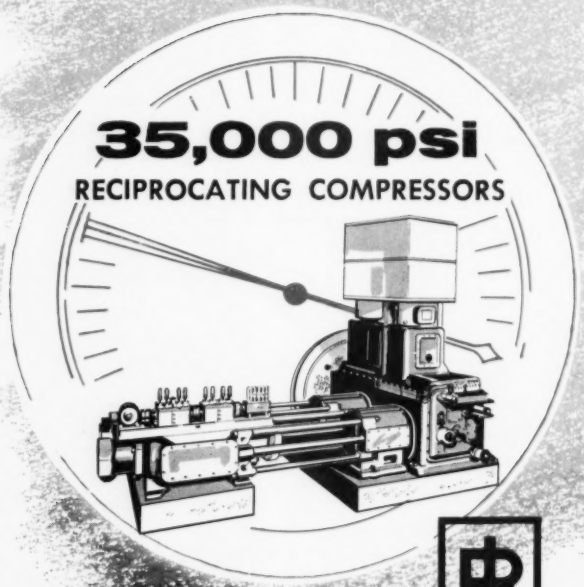
hi-psi*







These gauges show high levels of gas and liquid pressures created by machines designed and built by Ingersoll-Rand.

Such pressures have not always been practical. Most top levels have crept up little by little as new processes in industry demanded higher and still higher pressures. Those indicated here are bold advances, much higher than the preceding highs. Each is another building block in the foundation of experience.

Through a half century of such experience Ingersoll-Rand has been closely associated with the process and petrochemical industries. If you need to compress a gas, or pump a liquid at any pressure you choose to call high, take advantage of Ingersoll-Rand's experience that has continuously set the pace in high-pressures.

* **hi-psi** . . . high pressures, measured in pounds per square inch.

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I-681

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